DOCUMENT DE REVISIÓ DEL TFG

Títol del projecte: Assessment of the inorganic municipal waste management in Bhimpedi (Nepal) and improvement proposals.

Nom de l'alumna: Ainoa Plaza Cabrera.

Nom dels professors membres del tribunal: Jordi Izquierdo, Lourdes Reig, Montse Gallart.

Durant la revisió del document s'han realitzat diversos canvis de reestructuració amb la finalitat de que fos més coherent i entenedor.

Els errors d'edició, així com de gramàtica, paraules i frases mal expressades, han estat corregits.

Específicament en resposta als comentaris dels revisors:

OBJECTIUS

- *S'han modificat per a fer-los més entenedors.*

ESTRUCTURA

- *S'ha afegit un índex de figures i un índex de taules.*
- *S'ha modificat el punt 4 de resultats en general.*
- *Part de la informació que hi havia a l'apartat 4.2 s'ha passat a la introducció.*

CONCLUSIONS

- *S'ha afegit un punt per a les propostes.*
- *S'han modificat alguns punts per fer les conclusions més clares.*

CORRECCIONS

- *S'ha revisat el redactat en anglès de tot el text.*
- *S'han corregit els canvis suggerits pels revisors així com altres que s'han trobat durant la revisió.*
- *S'ha revisat la bibliografia.*

Escola Superior d'Agricultura de Barcelona

UNIVERSITAT POLITÈCNICA DE CATALUNYA

FINAL DEGREE WORK

ENGINERING OF BIOLOGICAL SYSTEMS

ASSESSMENT OF THE INORGANIC MUNICIPAL WASTE MANEGEMENT IN BHIMPEDI (NEPAL) AND IMPROVEMENT PROPOSALS.

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Castelldefels, June 2018

Aquest estudi forma part d'un projecte de cooperació internacional realitzat a través del Centre de Cooperació per al Desenvolupament (CCD) de la UPC. El títol és "Projecte de gestió de residus municipals orgànics i inorgànics per a la millora del medi ambient a Bhimpedi, Nepal" amb codi 2017-O016.

En aquest projecte van participar tres estudiants de l'Escola Superior d'Agricultura de la UPC: la Daylí Remuiñan Ackermann, la Maria Assens Blanch i l'Ainoa Plaza Cabrera.

Del projecte han sortit dos treballs de final de grau: "Gestión de residuos orgánicos en una comunidad rural (Bhimpedi, Nepal): diagnóstico de situación y propuestas de mejora", realitzat per la Daylí Remuiñan, i el present estudi "Assessment of the inorganic municipal waste management in Bhimpedi (Nepal) and improvement proposes", realitzat per l'Ainoa Plaza.

La Maria Assens va realitzar l'estada al Nepal i va ajudar amb el treball de camp. En el present document, quan es parla de "nosaltres" és perquè l'estudi es va dur a terme juntament amb l'ajuda de la Daylí i la Maria.

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Assessment of the inorganic municipal waste management in Bhimpedi (Nepal) and improvement proposals.

Author: PLAZA CABRERA, Ainoa

Tutor: LÓPEZ MARTÍNEZ, Marga

Summary:

Nepal is a country where waste management is deployed unevenly depending on the areas and, especially, whether it is urban or rural areas. Waste management in many places is not planned and the participation of citizens is not uniform. The 2015 earthquake aggravated a situation of environmental degradation, from the absence of appropriate urban services, such as wastewater treatment or waste management, to soil erosion or deforestation.

The municipality of Bhimpedi, located about 60 km south of Kathmandú, has a population not elevated but distributed between urban and rural areas, and in small communities far from the centre. Regarding the waste management, this means that considering a total management is very complex.

The project aims to make an identification and diagnosis of municipal waste generated in the municipality, especially of inorganic (plastic, glass and paper). That is why we want to identify the types of waste produced, approximate the quantification, evaluate the possible routes of management and diagnose the most appropriate in case it is necessary. Is needed also to find out what are the current management channels and on this premise, evaluate other existing or new possibilities.

Keywords: waste management in developing countries, inorganic waste, *kabaddi*, Bhimpedi, Nepal

Avaluació de la gestió inorgànica de residus municipals a Bhimpedi (Nepal) i propostes de millora.

Autora: PLAZA CABRERA, Ainoa

Tutora: LÓPEZ MARTÍNEZ, Marga

Resum:

El Nepal és un país on la gestió de residus està implantada de manera desigual depenent de les àrees i, especialment, si es tracta de zones urbanes o rurals. La gestió de residus en molts llocs no està planificada i la participació de la ciutadania no és uniforme. El terratrèmol de 2015 va agreujar una situació de degradació mediambiental, des de l'absència de serveis urbans apropiats, com el tractament de les aigües residuals o la gestió dels residus, fins l'erosió del sòl o la desforestació.

El municipi de Bhimpedi, situat a uns 60 km al sud de Kathmandú, presenta una població no elevada però distribuïda entre àmbit urbà i rural, i en petites comunitats allunyats del centre. De cara a la gestió de residus, això fa que plantejar-se una gestió total sigui molt complex.

El projecte pretén fer una identificació i diagnosi dels residus municipals generats al municipi, especialment dels inorgànics (plàstic, vidre i paper). Per això es vol identificar els tipus de residus que es produeixen, aproximar la quantificació, valorar les possibles vies de gestió i diagnosticar la més adequada en cas de que sigui necessari. També s'haurà de detectar quines són les vies de gestió actual i sobre aquesta premissa avaluar altres possibilitats existents o noves.

Paraules clau: gestió de residus en països en vies de desenvolupament, residus inorgànics, *kabaddi*, Bhimpedi, Nepal

Evaluación de la gestión de residuos municipales inorgánicos en Bhimpedi (Nepal) y propuestas de mejora.

Autora: PLAZA CABRERA, AINOA

Tutora: LÓPEZ MARTÍNEZ, Marga

Resumen:

Nepal es un país donde la gestión de residuos está implantada de manera desigual dependiendo de las áreas y, especialmente, si se trata de zonas urbanas o rurales. La gestión de residuos en muchos lugares no está planificada y la participación de la ciudadanía no es uniforme. El terremoto de 2015 agravó una situación de degradación medioambiental, des de la ausencia de servicios urbanos apropiados, como el tratamiento de las aguas residuales o la gestión de los residuos, hasta la erosión del suelo o la deforestación.

El municipio de Bhimpedi, situado a unos 60 km al sur de Kathmandú, presenta una población no elevada pero distribuida entre ámbito urbano y rural, y en pequeñas comunidades alejadas del centro. De cara a la gestión de residuos, esto hace que plantearse una gestión total sea muy complejo.

El proyecto pretende hacer una identificación y diagnosis de los residuos municipales generados en el municipio, especialmente de los inorgánicos (plástico, vidrio y papel). Por eso se quiere identificar los tipos de residuos que se producen, aproximar la cuantificación, valorar las posibles vías de gestión y diagnosticar la más adecuada en caso de que sea necesario. También habría que detectar cuales son las vías de gestión actual y sobre esta premisa evaluar otras posibilidades existentes o nuevas.

Palabras clave: gestión de residuos en países en vías de desarrollo, residuos inorgánicos, *kabaddi*, Bhimpedi, Nepal

Summary

Index of figures

Index of tables

1. INTRODUCTION

1.1. Municipal solid waste

In the recent years humanity has evolved rapidly and, in a considerable way in aspects such as medicine or technology, increasing the quality of life of people. The negative influence on the environment has been underestimated for many years since much more importance has been given to economic growth rather than to the degradation of environment.

As forests and other non-renewable resources are reduced, all ecosystems become more vulnerable to destruction, pollution and erosion. Environmental problems affect virtually all the nature elements: water, soil, vegetation cover, animals and climate.

One of the most serious environmental problems, generating a great impact of pollution on natural resources, ecosystems, health and the quality of the environment is the generation of solid waste or rubbish. Any alteration that affects negatively the environment is considered an environmental problem.

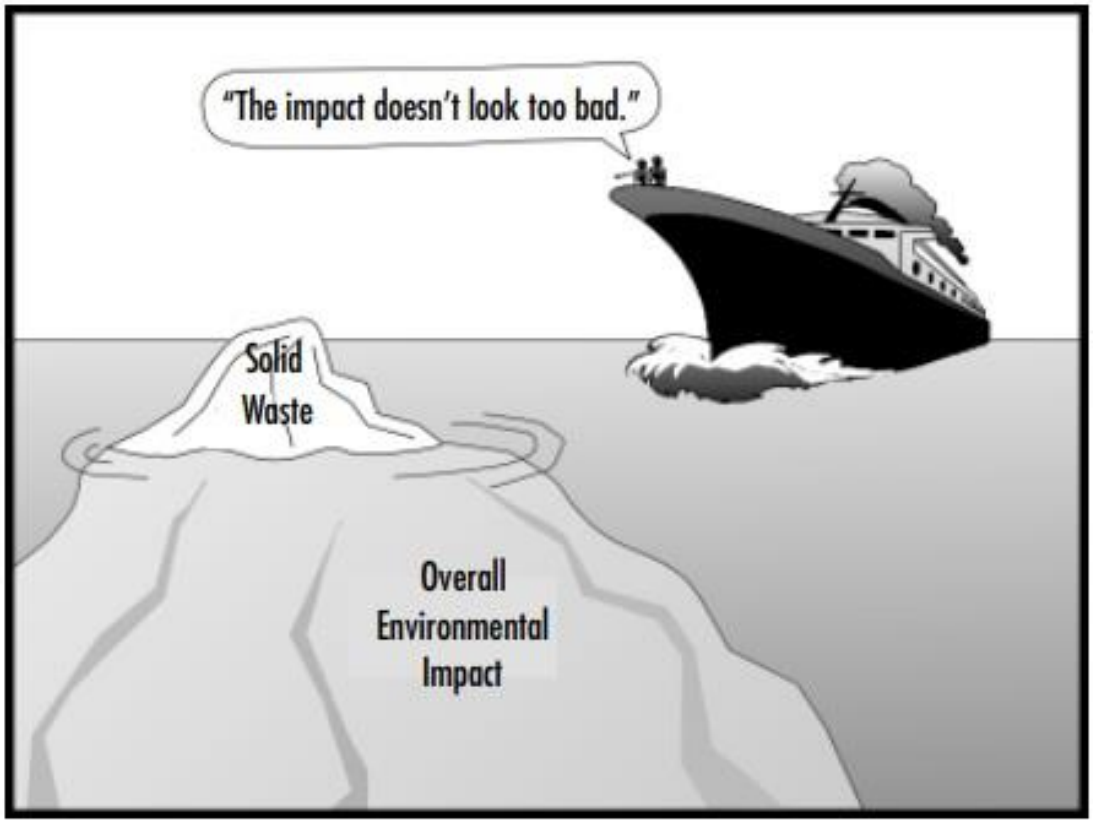


Figure 1. "The impact doesn't look too bad". (What a waste: Solid Waste Management in Asia, 1999).

'Waste' means any substance or object which the holder discards or intends or is required to discard (EC, 2008). Solid waste can be made up of organic materials that easily decompose (leaves, branches and household foods or bio-waste), inorganic materials with long degradability (plastics, synthetic fabrics, paper or glass) and hazardous materials (medical or surgical material, batteries or acids and corrosive chemicals) among other.

Depending on their origin, they can be classified as domiciliary (household waste), industrial (factories or companies), hospitals (hospital, medical or surgical waste), commercial (business or shops), urban (population) or spatial (objects or artificial fragments).

Waste classification in Europe is based on the European List of Waste (Commission Decision 2000/532/EC) and Annex III to Directive 2008/98/EC. The list of waste is intended to be a reference nomenclature that provides a common terminology throughout the Community with the aim of improving the efficiency of waste management activities. The List of Waste (LoW) serves as a common coding of waste characteristics in a

wide variety of objectives such as the classification of hazardous waste. The classification of waste codes affects the transport of waste, installation permits, decisions on recyclability of waste or as a basis for waste statistics.

Directive 2008/98/EC establishes the basic concepts and definitions related to waste, such as definitions of waste, recycling, recovery and how to distinguish between waste and by-products. The EoW (end-of-waste) criteria defines when a waste becomes a secondary raw material. The Directive establishes some basic principles of waste management: take management actions regarding human health and environment protection, with special consideration to water, air, soil, plants or animals, and avoiding disturbances due to noise, odours or other pollution.

The waste legislation and policy of the EU Member States shall apply as a priority order following the waste management hierarchy (Figure 2):

Figure 2. Waste management hierarchy according to the European Commission (EC,2008).

The Directive introduces the "pay as you throw" principle and the "extended producer responsibility". It incorporates provisions on hazardous waste and used oils (old Directives on hazardous waste and waste oils being repealed with the effect from 12 December 2010), and includes two new recycling and recovery goals to be reached by 2020: 50% preparation for reuse and recycling of certain residues from households and other similar sources to households, and 70% prepared for reuse, recycling and other recoveries of construction and demolition waste. The Directive requires Member States to adopt waste management programs and waste prevention programs.

The consequences of solid waste are mainly about the deterioration and quality of human health, environment, landscapes, ecosystems, and all that leads to the proliferation of pathogens causing diseases. That is why a correct treatment is needed to each type of waste.

It is estimated, according to the report of the What a Waste (WB, 2012), that every year world cities generate about 1,3 billion tonnes of solid waste, however, around 3,000 million people do not have access to controlled waste management facilities. This volume is expected to increase up to 2,2 billion tonnes by 2025. Waste generation rates will be more than double over the next twenty years in lower income countries. Income influences and in fact, high income countries are currently the largest producers of urban garbage in the world. However, this trend will revert, since it is estimated that in the next decade, the urban population of low-middle income countries will increase by more than 700 million people, significantly increasing consumption and leading to greater amounts of waste in the cities. It is estimated that, in 2050, the number of people who would not have access to waste management services would rise to 5.300 million people in the world. It is estimated that 70% of the solid waste generated is sent to landfills while only 19% is recycled or recovered and 11% is converted into energy in recovery facilities.

According to CEAMSE[1] data (2017), the country that generates more waste per person is Bahrain. Each citizen of this country on the west coast of the Persian Gulf generates 906 kg of solid waste per year. This is due to high population growth rate, rapid industrialization, high per capita waste generation, unorganized

[1] Coordinación Ecológica Área Metropolitana Sociedad del Estado. Argentinian public company for waste management in Buenos Aires

solid waste management sector, limited land resources and poor public awareness. Bahrein is followed by another group of islands, the Comoros, in the Indian Ocean. Then, there are Canadians with 777 kg per year and Americans with 747 kg. The opposite list, of those that generate least, is led by Kenyans with 109,5 kg per person and year, behind Ethiopia with 109,8 and Nepal with 115,7 (Figure 3).

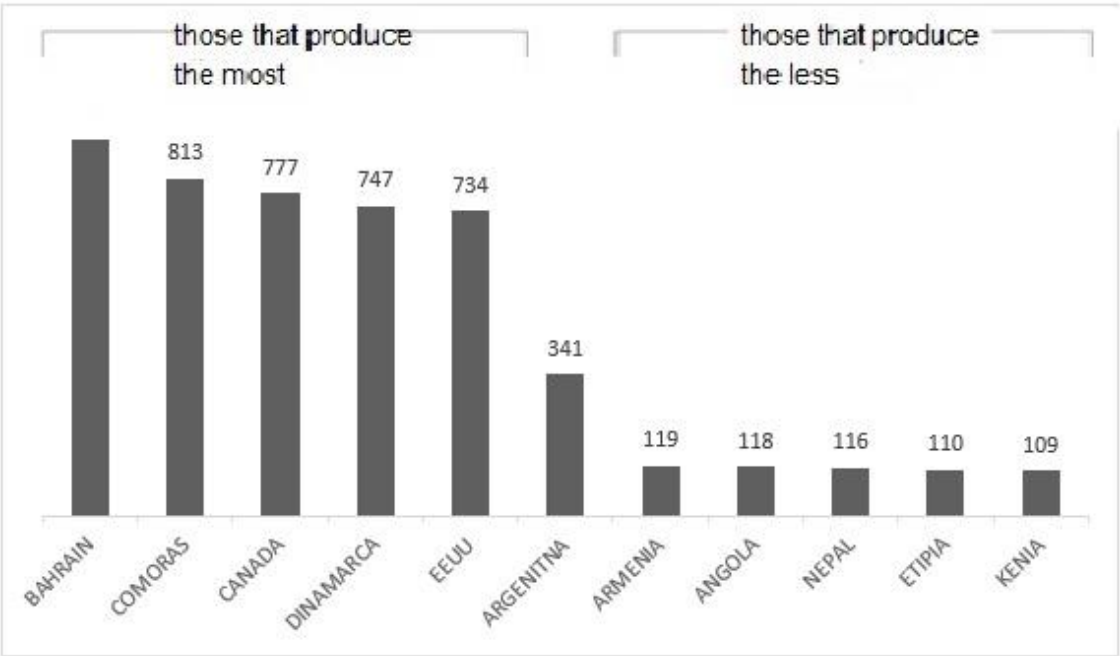


Figure 3. The countries that generate more and less waste in kg/year per capita (CEAMSE, 2017)

The graphic in Figure 4 shows the countries that generate more quantity of waste, regardless of the number of inhabitants they have. In 2004 China surpassed the United States as the largest waste generator in the world. By 2030, China would probably produce twice as much solid municipal waste as the United States due to increase in population and consumption.

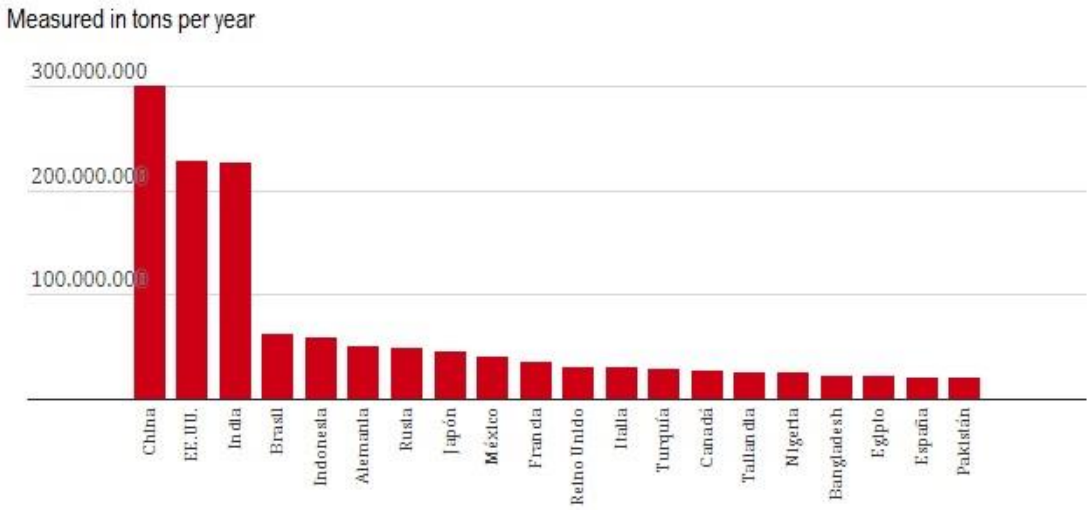


Figure 4. The 20 countries that generate more waste (Waste Atlas, 2017)

The degradation time of the waste varies according to the its composition and the environment conditions such as moisture, temperature or acidity. The time of degradation of a brick is 30 years, a plastic bag at least 150 years, the batteries 1.000 years and the glass takes about 4.000 years.

There are many options to eliminate or reduce the amount of waste generated. But first, it is important to be aware of the existing problem and to take part of the solution because, in the end, the benefits obtained are useful for everyone.

There are different techniques or strategies to manage such, both organic or inorganic. These includes landfills, incineration, composting and anaerobic digestion, mechanical-biological treatment, pyrolysis or gasification. The pros and cons they present are different and the selection of a technique might be specific for every case.

There are also alternatives to consider, which are very useful to reduce the amount of waste generated (prevention of waste), such as: promoting social education so that everyone knows the magnitude of the problem, environmental sanitation, recycling and the "3R" (reduce, reuse and recycle), ecological habits, comprehensive waste management, respect and compliance with the legal framework, pollution prevention, energy recovery and controlled landfill. Actions that we can carry out if we all make an effort and become aware.

The range of possibilities can be very broad, but it requires collaboration of citizens, government, companies, institutions, organizations and societies in order to reduce waste problem by the will and responsibility of all.

In addition, an adequate waste management helps to create jobs and thus helps the country's economy grow.

There is a website that gives an account in real time of how much garbage is generated in each country (Figure 5). It is called "Waste Atlas" (http://www.atlas.d-waste.com/) and is a crowdsourcing open source map that, through an interactive map, shows global data on solid waste management to compare and evaluate the impact of each country on the environment. This is working since 2013 and is an initiative, nonprofit, driven by organizations such as D-Waste, ISWA (International Solid Waste Association), WtERT (Waste-to-Energy Research and Technological Council), SWEEP-Net, SWAPI and the University of Leeds. This program already includes data for 164 countries, 1799 cities, 1626 sanitary landfills, 93 dumpsites, 130 MBT (mechano-biological treatment) units, 78 biological treatment and 716 WtE (Waste to Energy) plants. The figures published in this website are firstly checked for mistakes or inconsistencies, but it is known that is each country who supplies his own information, so we cannot know for sure if these data are 100% real.

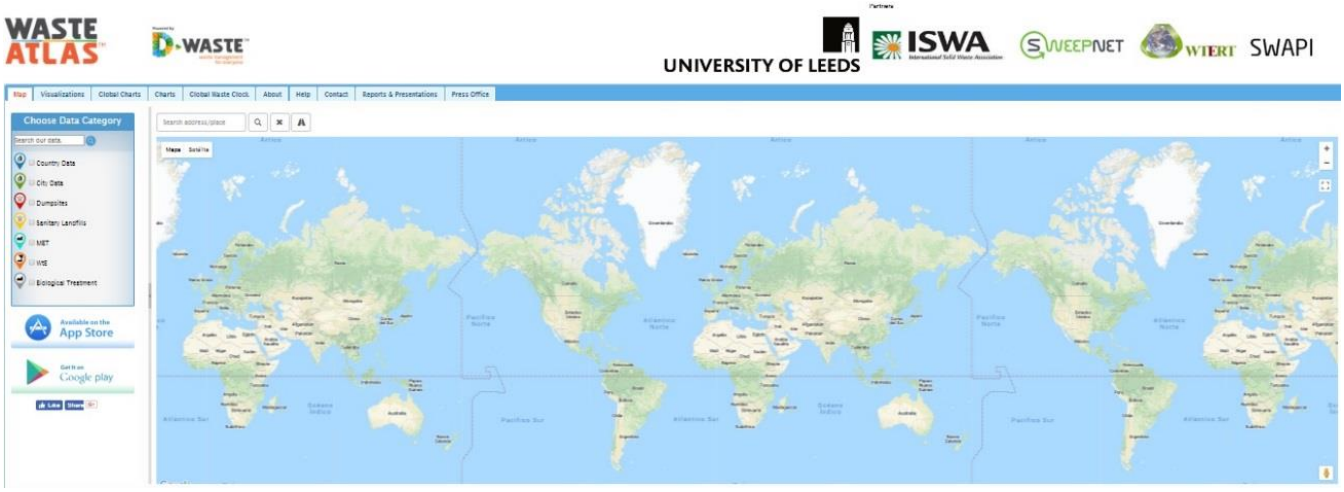


Figure 5. Waste Atlas website

The purpose of this webpage is very valuable, in order to assess the waste treatment capacity in each country, and then, overworld. Nevertheless, for the best of our knowledge, regarding the data about Catalonia, a lack of information has been observed.

Despite its importance, reliable global municipal solid waste information is usually unavailable. The data are often incompatible, incomparable and incomplete.

"The urgent response to the problem of the global garbage mountain is not only a need for public health and the environmental, it is also a sensible economic investment. Doing nothing costs countries around 5 or 10 times more than investing in a good waste management system. A great deal of nations for the systematic application of the "3Rs" – reduce, reuse, recycle – can transform the waste problem into resources for our economies". –

Achim Steiner,

former Executive Director of UNEP (United Nations Program for the Environment).

1.2. Municipal solid waste in developing countries

The concept of developed countries describes those countries that have a high level of development in aspects such as life expectancy, education, socioeconomic status, the human development index and the illiteracy rate. Generally, the countries that invest the most in education tend to be more developed countries, because usually the greater the knowledge, the more competitive their economy is.

On the other hand, developing countries refer mainly to the degree of economic development. It is applied to nations characterized by a delay in terms of human development of a significant segment of their population, a high level of social inequality, institutional weakness and political instability. The development of a country is also measured with statistical indexes such as per capita income (GDP), life expectancy, literacy, etc.

The UN (United Nations) has developed the HDI (Human Development Index), an indicator composed of the statistics previously mentioned, to gauge the level of human development of the countries. Developing countries generally do not achieve a significant level of industrialization in relation to their populations, and that do not have a high standard of living. There is a strong positive correlation between average income and high population growth. This also moderates the incorrect tendency to believe that the standard of living throughout the developing world is the same.

Two thirds of the world population live in developing countries, mostly in Latin America, Africa and Asia. Developing countries are also known as "third world countries", (Candelaria, 2018). They are named in this way because of the Cold War, when two opposing hegemonic blocs dominated international politics, the Western led by the United States (first world) and the Union of Soviet Socialist Republics (USSR) and their allies (second world). The "third world" was made up of the least developed countries, economically and technologically, with an unequal level of development and with political ideologies, religion and cultures very diverse. All of them with a large proportion of their population below the poverty line; economic dependence from abroad; little participation in the international system, etc.

The application of the term developing country or even emerging country for some of the less developed countries could be considered inappropriate: several poor countries are not improving their economic situation (as the term implies), but have experienced prolonged periods of slump.

Most developing countries and the least developed are facing current development challenges because of emerging global economic crises. One of these challenges is the management of solid waste.

Solid waste is generally considered an urban issue. Waste generation rates tend to be much lower in rural areas since, on average, citizens are usually poorer, purchase fewer store items (which results in less packaging), and have higher levels of reuse and recycling. It is because they use all the organic waste for feeding the animals or for composting, they also usually use, for example, plastic bottles to refill with drinking water. In urban areas of most developing and least developing countries, the urban solid waste generated is collected and disposed, at best, in arbitrary dumping sites that, in their majority, do not have the appropriate regulations. In other countries, solid waste management, are found in water lands and water bodies, and a part of the waste is uncontrollably burned to reduce its volume. These practices have negative environmental impacts that range from pollution of natural resources and ecology to the creation of health problems that could become long-term public health problems.

The increase in the waste generated per capita per day is linearly proportional to GDP (Gross Domestic Product) per capita. The high-income countries are currently the largest producers of urban solid waste in the world, contributing to the 46,7% of the global generation. However, this trend will revert, since it is estimated that, in the next decade, the urban population of middle and low-income countries (currently 43,3% of the world's urban population) will increase by more than 700 million people, significantly increasing consumption and leading to greater amounts of waste in cities. (WB, 2012).

For example, there are high-income countries in the Middle East and other middle and low-income countries. The percentage per inhabitant of municipal solid waste is quite diverse, but reflects the level of income of each country, as we can observe on Figure 6.

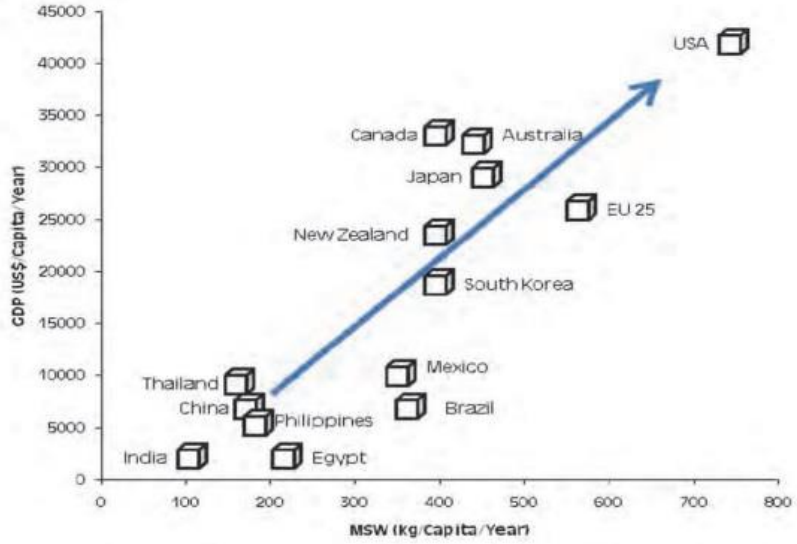


Figure 6. Countries income and the rate of generated municipal solid waste (UNDESA[2], 2010)

Middle and low-income countries in Southeast Asia have a similar generation rate per capita of municipal solid waste, but they have a different percentage composition of municipal solid waste, dominating organic waste in most of them.

Most of the municipal solid waste in most developing countries are degradable and recyclable. If managed correctly, such municipal solid waste would provide great opportunities for the socioeconomic development of the countries.

There are different municipal solid waste management options in the developing countries. The main problem that faces the proper management of municipal solid waste in many developing countries is the lack of adequate administrative and financial resources. There is no clear and reliable framework for management from the phases of collection, transformation to disposal or treatment. Normally, this situation is accompanied by the limited investment assigned to the municipal solid waste sector with complications of raising or increasing the appropriate service rates. Municipal solid waste management activities are considered public services that are directly controlled by government institutions. These management arrangements are considered weak as they do not have market mechanisms and economic incentives cannot be used to improve and develop municipal solid waste management services.

The absence of comprehensive and effective legislative frameworks to regulate the sector of solid waste management as well as inadequate mechanisms of application become also a problem. Regulations are also critical for the application of legislative frameworks, especially those that affect the configuration, design and operation of landfills and the treatment of possible hazardous and sanitary wastes. In many developing countries with financial resources availability, there are deficiencies both in human capacity and in the organization.

The last important issue related to municipal solid waste management in developing countries is the availability of a significant amount of accurate background data and waste status information such as the generation rate, evaluation of the natural resources and the needs of land use, collection and transport, treatment scenes, growth scenes of solid waste that are linked to different motor effects. Data and information are fundamental elements for developing the municipal solid waste management system, including the appropriate monitoring of the sector.

[2] United Nations Department of Economic and Social Affairs.

The OECD countries (Organization for Economic Co-operation and Development) produce at least half of the world's waste, these countries are: Andorra, Australia, Austria, Belgium, Canada, Czech Republic, Denmark, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Japan, South Korea, Luxembourg, Monaco, Netherlands, New Zealand, Norway, Portugal, Slovak Republic, Spain, Sweden, Switzerland, United Kingdom and United States. On the other hand, Africa and the South Asian regions are the ones that produce less waste. (WB, 2012).

"The municipal waste generation in Catalonia in 2016 is 496,4 kg/inh/year, slightly higher of the European average for 2015 : 477 kg/inh/year"

Waste Agency of Catalonia

Annual Report 2016

Waste generation varies depending on the influx of people, however, the regional and national variations can be significant, as well as the generation rates within the same city.

The OECD countries generate 572 million tonnes of solid waste per year. The range values per capita are between 1,1 and 3,7 kg per capita and day, with an average of 2,2 kg/capita/day.

The generation of waste in sub-Saharan Africa is approximately 62 million tonnes per year (in general, data are insufficient for sub-Saharan Africa). Generation of waste per capita is generally low in this region, but the values range from 0,09 to 3,0 kg per capita per day, with an average of 0,65 kg/capita/day. Countries with the highest rate per capita are islands, probably due to the waste generated by tourism and a more complete accounting of all the waste generated.

In the Middle East and North Africa, the generation of solid waste is 63 million tonnes per year. Generation of waste per capita is from 0,16 to 5,7 kg per capita and day and has an average of 1,1 kg/capita/day.

The annual waste generation in East Asia and the Pacific region is approximately 270 million tonnes. This amount is mainly influenced by the waste generation in China, which represents 70% of the total regional. The generation of waste per capita ranges between 0,44 and 4,3 kg per capita per day, with an average of 0,95 kg/capita/day.

In Eastern and Central Asia, the waste generated per year is at least 93 million tonnes. Eight countries in this region do not have available data on waste generation. The generation of waste per capita ranges from 0,29 to 2,1 kg per capita and day, with an average of 1,1 kg/capita/day.

Latin America and the Caribbean has the most complete data. The total amount of the waste generated annually in this region is 160 million tonnes, with values per capita ranging from 0,1 to 1,4 kg/capita/day and an average of 1,1 kg/capita/day. Similar to the high rates of waste generated per capita in the African islands, the highest rates of solid waste are found in the Caribbean islands, probably also due to tourism.

In South Asia, approximately 70 million tonnes of waste are generated in a year, the range values per capita are from 0,12 to 5,1 kg per capita and day with an average of 0,45 kg/capita/day.

It is estimated that the volume of the waste generated in the cities of Africa and Asia will double by 2030, according to the report Global Waste Management Outlook by UNEP (United Nations Environment Program) and ISWA (International Solid Waste Association).

The sum of the generation of waste from countries that do not belong to the OECD countries is 618 million tons per year in front of the 572 million tons per year generated by the OECD countries. Two-thirds of the world's population generate approximately the same waste as the OECD countries, which make up the remaining third of the world's population.

The Intergovernmental Panel on Climate Change (IPCC, 2007) defined vulnerability of people as their propensity to be harmed due to their exposure to stresses including climate stress. It is believed that the continuous increase emissions of greenhouse gases (GHG) several decades ago due to human anthropogenic activities resulted in the global climate change, which turned to be the most serious challenge facing development in the 21st century. The accumulation of GHG emissions in the atmosphere, in particular carbon dioxide (CO_2) and Methane (CH_4) is believed to be responsible for the global warming and the associate frequent occurrence of extreme climate events. CO_2 concentration in the atmosphere has risen to 391 ppm by end 20101; an increase of about 6% compared to records of 2000. The 2010 world energy statistics (BP, 2010) show that 44% of total CO_2 emission comes from 17% of the world total population

(developed nations) while the rest 83% of the world population (developing and least developed) contributes to the rest half of the total emissions (Figure 7).

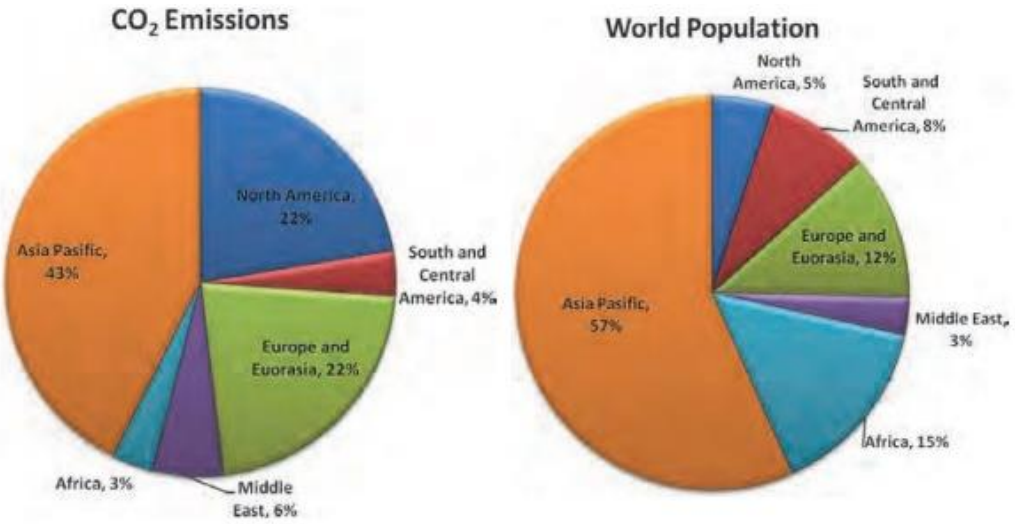


Figure 7. Comparison of World Population and CO_2 emission (BP, 2010)

1.3. Study area description

1.3.1. Nepal

Nepal is a small country of 147.181 km^2, 800 km in length and 200 km in width, located in south Asia, between China in the north and India in the south, east and west (Figure 8, Figure 9).

Figure 8. Asia map (Instituto Nacional de Estadística y Geografía, 2018)

Figure 9. Nepal map (Instituto Nacional de Estadística y Geografía, 2018)

Nepal has a population of 28.981.346 (UNDP, 2016), of which 1.224.000 live in Kathmandu, the capital of the country. It is divided into three geographical areas: the Himalayan region, mid hill region, an area that is located on the south of the previous one, and the Terai region or the lower zone. The highest point in the country is mountain Everest (8.848 m) while the lowest point is in the Terai plains of Kechana Kalan in Jhapa (60 m).

The population density of Nepal is 196.9 inhabitants / km^2 (UNDP, 2016). Compared to data from Spain, in which the population is 46,549,045 and has an area of 505,940 km^2 and a population density of 92 inhabitants / km^2 (datamacro, 2017), it is observed that Nepal's population density is much larger, although it is a smaller country than Spain. Nepal is a small country that gives the impression of being a sparsely populated country, but this is not the reality.

Despite being a very small country, Nepal has a lot of climatic variation according to the geographic characteristics, the great difference of heights in all the country and the little distance between the north and the south has influence. This country has from tropical areas to peaks over 7,000 meters. During the months of January to March is when temperatures are lower (cold period).

Nepali is the official language of the country, the mother language of 58,4% of the population and the common language, although there are many others, up to 72 different languages and dialects.

Regarding to religion, it is considered a country with great tolerance and religious diversity, Hinduism is officially established (81,3%), but Buddhism (9%) and others, like Islam, Kirat and Christianism are also practiced.

Nepal must face important challenges that affect national stability. In addition to political causes, national problems are also rooted in the different social and economic gaps. For example, the castes system, despite the end of the civil war (1996 - 2006) and the republic proclamation in 2008, higher castes continue to enjoy exclusively the privileges of political and economic power.

Nepal is a developing country with a low-income economy, occupying 145 of 187 countries in the Human Development Index (IDH) in 2014. It continues fighting against the high levels of hunger and poverty. However, the country has been in constant progress. Economic problems include the reconstruction after the earthquake that took place in 2015. The coalition government continues working in the reconstruction of Nepal.

The government of Nepal is currently governed by President Bidhya Devi Bhandari, the first woman president in Nepal, elected in October 2015 in a parliamentary vote. The position of president is mainly

ceremonial. The Prime Minister Khadga Prasad Sharma Oli, president of the communist party of Nepal, he was sworn in last February 2018.

Figure 10. Nepal flag (google.com)

The flag of Nepal (Figure 10) is the only national flag in the world that is not rectangular. According to its official description, the red of the flag represents victory in war or bravery, and it is also the colour of the rhododendron, the national flower. The blue border of the flag means peace.

In the central zone two white symbols are identified. There are different interpretations about what these figures represent. Some say that both figures represent the calm and steely determination of the Nepali people, others that symbolize the shadows and cold of the Himalayas in contrast to the warmth of the Terai region, and others interpret these figures as the Nepal Kingdom will remain as long as the sun and the moon.

In 2015 an earthquake took place in Nepal. Already before the earthquake, Nepal had serious environmental problems, from the absence of appropriate urban services, such as wastewater treatment or waste management, to land erosion or deforestation. The earthquake increased and worsened these environmental degradation problems, leaving millions of tonnes of waste to be treated. It is estimated that approximately 3,94 million tonnes of waste were generated, plus those generated in the campaign tent camps where millions of inhabitants took refuge after the earthquake.

The composition of the waste after the earthquake includes concrete, asphalt, bricks, sand, stones, domestic waste, metals, paintings, medicines, pesticides, fertilizers, chemicals of laboratories, electrical and electronic devices, etcetera; many of these waste are dangerous, as they can pollute soil and water without a proper treatment. To avoid this pollution, which would ultimately affect citizens and environment, waste must be segregated for recycling, reuse or reconstruction. However, treating waste in an emergency situation in a country where waste management is deficient, is a complicated challenge.

Another challenge that involves the waste management after an earthquake is to have an appropriate space to place them, as well as the necessary conveyance to transport them. We cannot forget the important damage to the communication routes, which hinders access to landfill sites.

Nepal ranked the number 145 in the world according to the “Human Development 2015 of the United Nations Development Program (UNDP)” report, which is why its capabilities to deal with catastrophe of such magnitude are very limited, not only by its economic resources, but also the absence of laws and regulations for waste management to face natural disasters.

1.3.2. Bhimpedi

Bhimpedi is a municipality located about 60 km southwest of Kathmandu, Nepal’s capital. It is part of Makwanpur district, in the Narayani zone, in the Mahabarat mountains at the valley limited by two rivers (Lamo Khola and Rapati Khola), at an altitude of 1150 meters. Bhimpedi population is 6.321 inhabitants (2001 census), 3.166 men and 3.155 women, of which 88,8% are dedicated to agriculture, directly or indirectly.

Until 1956, this town was a key point of passage to the Kathmandu Valley from India. After the construction of the Bahinse-Kathmandu highway and the subsequent transfer of Hetauda of the district capital, located 20 km southwest of Bhimpedi, it began to fade remarkably while the economy of its inhabitants also collapsed significantly, thus reducing the limited development opportunities in most of Nepal (see Figure 11, Bhimpedi in black).

The geographical coordinates of Bhimpedi are 27º33’0”N 85º7’30”E. Bhimpedi is within the territorial unit called Bhimpedi Gaupalika (Bhimpedi Ruler Municipality).

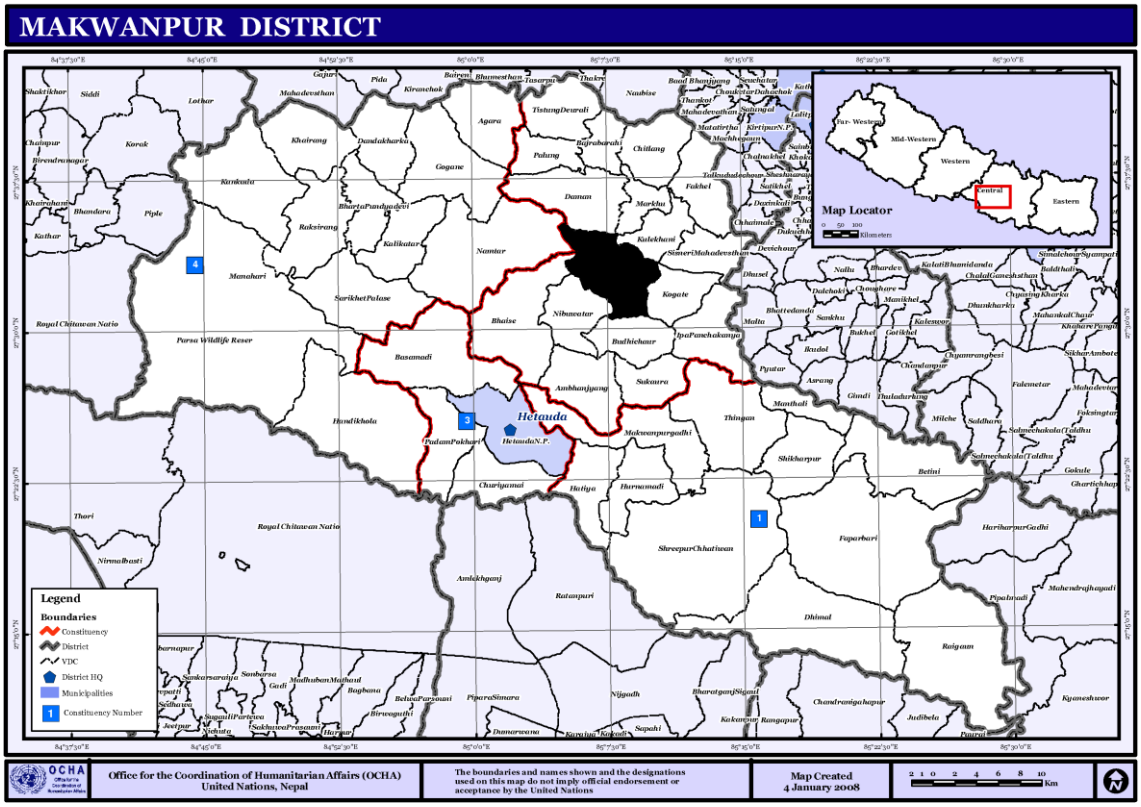


Figure 11. Bhimpedi in black in Makwanpur district (OCHA, 2008)

This municipality is divided into what are called "*wards*", which are a sort of neighbourhoods (**¡Error! No se encuentra el origen de la referencia.**5). Recently there has been a change in the territorial division of the area, before Bhimpedi was divided into 9 wards (Dhorsing, Bhimpedi Bajar, Paribajar, Targaun-Simaltar, Chabeli, Damar, Suping, Jurikhet and Jyamire), which have now been grouped into 2 wards, 5 and 6.

Each *ward* has a small committee, made up of 3 people, which is the local authority. These authorities of the wards depend on the mayor of Bhimpedi, the most authority person. These people are the political representatives of Bhimpedi, and are elected by the population in the elections.

1.3.3. Waste management in Nepal

Currently, the environmental management situation in Nepal affects both the health of the inhabitants and the environment. Nepal is considered a developing country and is one of those that generates less waste. Being one of the countries in which the amount of waste generated per capita is very low, garbage is very visible on the streets of the country, because of its poor waste management.

"The basic principle of waste management – to reduce, reuse and recycle – is not followed here. We have stayed with the same system that has been done for years, without any improvement", says the expert in solid waste management Dhundiraj Pathak. "If we do not recover and reuse our waste, our problem will never be solved."

More than 60% of the waste generated in Kathmandu is organic waste, which could technically be composted, but as long as garbage is not segregated, it increases in weight and volume. At the institutional level, waste management still does not seem to be a priority and is still seen as simply sweeping and dumping.

As usual in Nepal, the central problem is the lack of coordination, in this case between the municipality, the national government and trans-district jurisdictions. The problem has been aggravated by the confusion of how much responsibility has each of the three levels of government (national, provincial and local).

With the promulgation of the local self-government law in 1999, the municipalities are the authorities responsible for the management of the solid waste generated in the same municipalities. Most municipalities

opt for open dumping near riverbanks or in open areas. In Nepal, the disposal of solid waste through landfills is considered an important strategy in solid waste management. An article written in 2011 by Bijay Thapa and Ajac KC, Solid Waste Management at landfill sites of Nepal, says that there were only three operational landfill sites just to collect municipal and household waste. Although, when analysing waste from landfills, it was observed that there were also industrial and sanitary waste. Thapa, Bijay & KC, Ajay. (2011).

> Sisdole landfill site: the landfill covers a total area of 15 hectareas and consists of two valleys, the first valley of 11,200 square meters and the second valley of 9,501 square meters. (Source: Metropolitan City of Kathmandu). Sisdole was supposed to be a temporary landfill for two years, but it has been receiving garbage from the capital for more than a decade.
>
> Pokhara sanitary landfill: The total landfill area is 10 hectareas, with 4 hectareas of landfill and 1.5 hectareas of leachate. (Source: Municipality of Pokhara).
>
> Karaute Dande sanitary landfill: The total landfill area is 20 hectareas. The landfill is not considered a sanitary landfill, as it is not designed as one, although, there is a waste segregation plant, a composting unit and a plastic and paper collection plant. Coatings or perforated pipes are not used in the landfill. (Source: Municipality of Gorahi).

“It is a big project with a big investment, so it is obvious that it will take time. But the government keeps changing so we have to explain and negotiate with new people all the time”, said Nabin Bikash Maharjan, from the Clean Valley Company.

In 2009, the government announced a tender to outsource the waste management of Kathmandu to private companies. Six years later, two private companies: Nepwaste and Clean Valley Company, received the approvals.

Nowadays, Nepwaste, a Nepali-Finnish company, has signed a legal contract with the Municipality and other governmental entities, and currently they are awaiting approval from the ministry. Nepwaste and Investment Board Nepal (IBN) have joined a Public Private Partnership (PPP) for the management of solid waste in the Valley.

According to IBN, Nepwaste will carry out the number 1 project package, that includes the Metropolitan City of Kathmandu and nine neighboring municipalities: Budhanilkantha, Nagarjun, Tokha, Tarakeshwor, Gokarneshwor, Sankharapur, Dakshinkali, Kageshwori-Manohara and Chandragiri. The municipalities government must approve the service charge before implementing it.

IBN asked to Nepwaste to submit a plan to integrate existing solid waste workers from government agencies and private operators before providing conditional approval to their detailed project report. The integration of existing workers is considered one of the main challenges for the project to be successful, since IBN could interrupt the project if they are fired.

Another condition presented by IBN is related to the right over values found in the garbage. According to IBN, the government should have the ownership of the values found in the waste.

The Nepwaste company agreed to build a sanitary landfill and waste processing center in Bancharedanda in Nuwakot and a transfer station in Teku in Kathmandu to manage solid waste, at its own cost.

With this agreement, people in the Valley will receive services such as door-to-door waste collection, street sweeping and riverbank cleaning, surface drainage and public places cleaning, such as temples. In return, people have to pay Rs.219 per month as fees for the waste collection service.

Its objective is to replace the solid waste management current practice: street sweeping, collection and elimination through a practice oriented to resources and sustainable of reduction, reuse and recycling.

Garbage collected from households will be segregated into biodegradable and non-biodegradable waste. The company will convert garbage into organic fertilizer, petroleum products and natural gas, in addition to generating up to 5 MW of electricity. Most of the solid waste will be recycled and only 20 percent will be placed in the landfill.

IBN CEO (executive director) Maha Prasad Adhikari and the Nepwaste President Sangita Shresta, signed the Project Development Agreement (PDA) on behalf of their respective organizations. The PDA must be approved by the board of directors of IBN, which is chaired by the prime minister.

The PDA has granted a three-month transition period for the project developer to take over the existing waste management system. Nepwaste will start the waste collection three months after the PDA is approved, and will use the existing landfill in Sisdole until a new facility is built in Bancharedanda.

IBN has said that PDA negotiations will begin with Clean Valley Company, which will handle waste management in the metropolitan city of Lalitpur and adjoining municipalities in addition to Kirtiput and Bhaktapur in package numbers 2 and 3.

The estimated cost of the project is Rs5 billion for the first package and Rs2 billion for the second and third packages. Under the agreement, the project will be delivered to the government after 20 years of commercial operation.

It is expected that the involvement of the private sector promotes scientific and environmentally friendly practices and this will lead to an improvement in health and sanitation.

Inviting the private sector to invest not only will allow the government to share the investment burden, but also to ensure good functioning and maintenance activities over time. It is expected that the participation of the private sector will increase the efficiency of waste collection and processing, reducing the burden on landfills and other land resources.

In Kathmandu small companies dedicated to waste collection are appearing. In 2013, the Blue Waste to Value Pvt Ltd group partnered with the Society for the Environmental Conservation (SEC), a local initiative in Panga, Kirtipur, in a community waste management project. The idea was simple: segregate the waste at source, recycle what was possible and send only the waste to landfill. The project included a machine that converted organic waste into compost, and covered 600 homes until the 2015 earthquake, that stopped the initiative.

Without wanting to let the garbage go to waste, Nabin Bikash Maharjan, waste management expert, decided to do a business with Blue Waste. Kirtipur Waste Management Services (KWMS) was born, with Blue Waste providing financial, technical and managerial support and SEC that deals with collection, segregation and processing. The group has now expanded to 10 wards in Panga.

Segregated waste is classified as dry recyclable and wet waste (organic) and non-recyclable dry waste. Organic waste is converted into compost and recyclable dry waste, such as plastic bottles, is sold to trusted suppliers. Only non-recyclable waste is sent to landfill.

Each household pays Rs 250-450 per month for the service, depending on the amount of waste that they generate. Households that cannot pay for the service get it for free. Since the project was carried out, the volume of waste destinated to landfill has been reduced by 80%.

Blue Waste is partnering with Yak&Yeti and Hyatt Regency to manage hotel waste in a way that respects the environment. Of the 1.5 tons of waste collected there, some of the organic wet waste is converted into animal feed. The rest is classified at source, re-segregated, reused and recycled.

On the following figures (Figure 12, 13 and 14) can be observed the composition of garbage generated in Nepal, differentiating between households, commercial and institutional garbage. The amount of plastic waste is elevated and has increased on the last years.

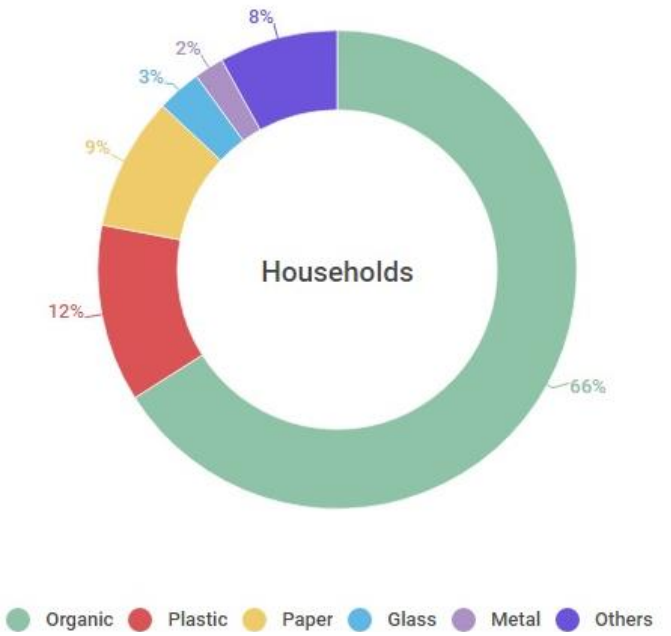


Figure 13. Composition of households garbage. Source: Solid Waste Management in Nepal - Current Status and Policy Recommendation, ADB, 2013.

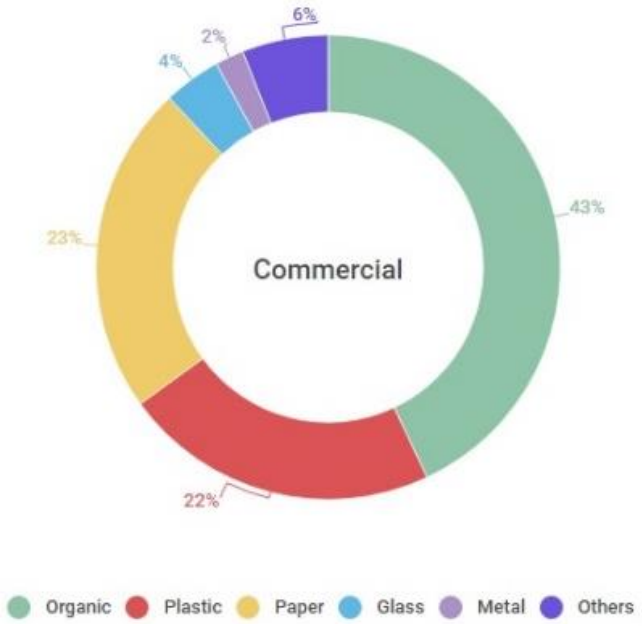


Figure 12. Composition of commercial garbage. Source: Solid Waste Management in Nepal - Current Status and Policy Recommendation, ADB, 2013.

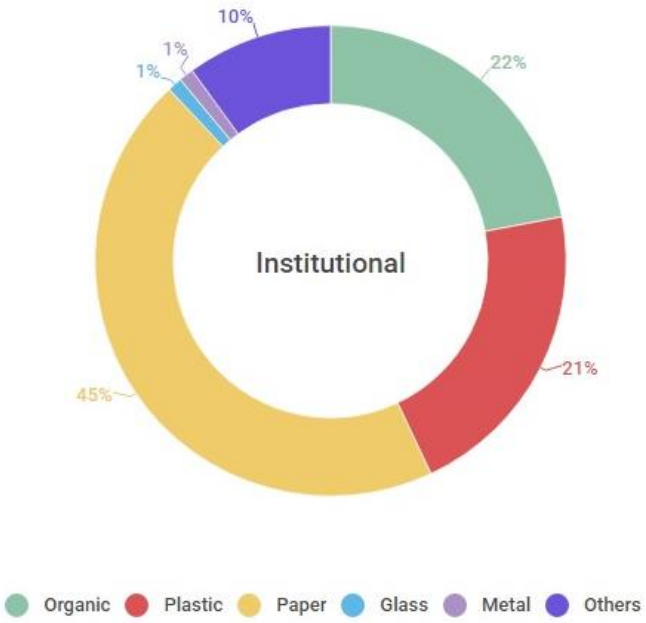


Figure 14. Composition of institutional garbage. Source: Solid Waste Management in Nepal - Current Status and Policy Recommendation, ADB, 2013.

The government has banned the use of plastic bags on multiple occasions, but the rule was never implemented correctly because few duties were made to offer alternatives to consumers. The plastic industries, which benefit from political patronage, say they were never consulted.

On July 17, 2016 came into force a nationwide ban on the use, sale, distribution, import and export of plastic bags. Plastic Bag Directive – 2071 had restricted production, sales and distribution of plastic bags below 30 microns.

There have been implemented in some municipalities a complete ban in the use of plastic bags, and a partial ban in other municipalities.

Calculations show that introducing a complete plastic bag ban across Nepal could stop some 1,250 million single-use plastic bags every year. Given the negative impact that plastic bags have on the environment, a complete ban should become a key part of government environmental policy. A strictly enforced ban on plastic bags use will reduce the number of plastic bags used by consumers by around 95%. Partial bans do not make economic sense since they are ineffective at reducing the use of plastic bags. In comparison, complete bans curb plastic bag use effectively.

Although, plastic entrepreneurs said that they will not stop producing plastic bags, and the public will not stop using them.

“The government has imposed the ban without offering alternatives”, said Chairman of Nepal Plastic Manufacturers’ Association Sharad Sharma, adding “The government has no legal grounds besides a previous directive that bans production and use of plastic bags below 30 microns. So, we do not need to close our factories.”

Director General at the Department of Environment Ganesh Kumar Shresta informed that although the ban was officially imposed on July 17, 2016, the government would not take any action in this regard. He said that a new directory will be needed to implement the ban, and the department is working on it.

1.4. Project background and motivation

Before this study, other studies have been made in this area of Nepal. *Amics del Nepal* manages a home-based property owned by the Nepal Children Organization (NCO) in Bhimpedi since 2007, where there are currently 30 children.

In 2003, “*Estudi de la situació agrària i social a la zona de Bhimpedi (Nepal): diagnosi i proposta d’alternatives”,* a study of the agrarian and social situation was carried out in Bhimpedi by two students of *ESAB* (*Escola Superior d’Agricultura de Barcelona - UPC*), in which they diagnosed the situation and proposed improvements.

In 2013, three students, from medicine, pharmacy and nursing, respectively, conducted a health report with the aim of compiling information about the health conditions in which the population and the health center of Bhimpedi were.

The *UPC* (*Universitat Politècnica de Catalunya*), along with *Amics del Nepal* and *Base-A,* a NGO of architects, promoted a project to improve the housing, also in Bhimpedi, from May 2015.

Plan Internacional, a Spanish NGO, has been working in Nepal since 1978, helping poor children to access their rights to health, education, economic security and protection. Ensuring that all children have access to quality education, helping thousands of children and families to recover from the 2015 earthquake and building a better future for children through good health practices. They were also working in Bhimpedi.

The Catalan Agency for Development Cooperation (*ACCD*) has subsidized part of Catalan ONGs projects that work in Nepal, and among others, has collaborated with *Amics del Nepal*. The Spanish Agency for International Development Cooperation (*AECID*) sent humanitarian aid after the earthquake took place in 2015.

While this study was realized, Daylí Remuiñan and Héctor Escudero, both students of *ESAB,* have carried out two studies on the organic waste management and agriculture, respectively.

An important NGO focusing on the environment and health improvement through the waste management is Clean Up Nepal. It emerged in 2013 after doctor Neelam Pradhananga was present during the Clean Up Australia campaigns, and she was asked to do something similar in Nepal and face the problem to end with the endless piles of junk found in the streets, especially from the big cities. This organization is registered as non-governmental and non-profit organization.

The Women’s Cooperative of Bhimpedi, Shree Mahila Jagriti Cooperative of Savings and Credits or also Community Center for Women Studying, was founded in the Nepalese year 2055 (our year 1999), and was formed thanks to the initiative of the NGO *Plan Internacional* that currently has no longer representatives in

the town, so the Cooperative is managed by the women themselves. The cooperative was created to keep and save money (for women and their children), credits for animals and agriculture. Workshops in agriculture and animal management are offered, and also workshops on account management, bookkeeping and health. Currently 1.300 women are part of the Cooperative. The requirements to become a member include to be a woman of Bhimpedi, of any of the *wards* (neighbourhoods) and over 20 years of age, or with the identity citizen card and they also must dedicate themselves to agriculture. It is essential to respect the rules of the cooperative, to attend meetings and to make economic contributions. At first men were reluctant to have their women organizing and holding meetings, but they realized that this is good for them, for the family and for society. Now women are stronger and more independent than before, as well as they can share and discuss everyday problems. Many women and families do not have enough money to invest or borrow in a normal bank, so this type of Cooperative is very important for them.

There is also an agricultural cooperative in Bhimpedi, *Agragaami Krisak Krishi Sahakaari*. The contribution of *Agragami* in *Awasuka* project is to provide local support for the organization of the participation of the people in the project.

The Japanese government has financed a building for a new school in the center of the town. And the Indian government was financing another school in Suping, but in this case they are building an agricultural school.

The present study arises from the collaboration between *Amics del Nepal*, *Base-A* and *CCD-UPC*, who jointly carried out a project called *AWASUKA, Aawaas Sudhar Karyakram*, from Nepali: Habitat Improvement Program, in order to develop an antisysmic reconstruction and habitat improvement program in the village of Bhimpedi, Nepal.

Given the problem that the country has, and that the earthquake worsened, and given the government's inability to take measures to improve population situation, NGOs and volunteers contribute to the improvement, as far as possible, of the Nepal inhabitant's life quality. In our case, in the improvement of a basic right such as housing, health and hygiene, all aspects related to waste management, among others.

From the *Awasuka* program they contacted the *ESAB* to tackle the problem of the waste management, both for support the deficiency of waste management, if not nonexistent. Thus, the proposal of this project considers the management of solid municipal waste to achieve an environmental and health improvement and the possibility of obtaining resources from waste and, thus, improve the inhabitants of Bhimpedi quality life.

It is clear that we have not the answer or the solution to problems, but we have experience and means to avoid making the same mistakes again. That is why international cooperation is important, not to impose ways of doing, but to try to improve what is in other countries.

As we have seen, many NGOs work in Nepal to improve in different areas such as education, health or housing, among others; perhaps it seems very difficult to achieve a change, but with small actions, together, can mean a great improvement.

In the field of waste, improving the waste management system of a country, we can reduce the environmental impact and avoid diseases, so in the end, the beneficiaries, are the citizens.

It should be said that the *Amics del Nepal* association is a non-governmental non-profit organization created in 1995 with the main objective of supporting and helping certain groups of people, basically boys and girls, young people and women, both directly and in collaboration with Nepalese organizations.

In relation to *Base-A*, it is a group of young architects and students who understand architecture as a tool for social transformation. Within the field of cooperation, they carry out activities from the point of view of sustainable and participatory development.

Finally, the Center for Development Cooperation (*Centre de Cooperació per al Desenvolupament, CCD*) is an entity of the *UPC* that was created in 1992 ate the initiative of its Social Council. *CCD* is created with the mission of promoting the active *UPC* involvement in development cooperation and supporting the realization of initiatives in this field by all *UPC* members.

"International cooperation will be vital to prevent developing countries from becoming landfills for hazardous materials".

Oyun Sanjaasuren, former president of the United Nations Assembly (UNEA).

2. OBJECTIVES

The main objectives of the work are mainly two which are split into different specific objectives, as explain below:

OG1. Analysis of the current situation of municipal waste management in Bimphedi

- Identification of the municipal waste generated in the study area
- Identification of the generating points
- Quantification of the waste generated
- Identification of the main treatments

OG2. Development of proposals for waste management improvement. These proposals will include:

- Promotion of the waste minimization
- Definition of new procedure waste management

3. METHODOLOGY

This project began in February 2017, with a preliminary research of the context of Nepal and the different waste management in developed countries and in developing countries to get know-how. The stay in Nepal began on September 7, 2017 until December 6, 2017.

With the aim of studying, knowing and understanding the waste management situation of Bhimpedi, the activities carried out can be summarized essentially in:

- Observation of local reality
- Identification of municipal waste generated (main materials produced)
- Identification of inorganic municipal waste management (non-existent)
- Quantification of inorganic waste generated in some family's home and in the orphanage
- Development of awareness activities about hygiene and waste management in the school of Bhimpedi
- Meeting with the mayor and other public entities of Bhimpedi
- Realisation of interviews with the population to collect additional information about their needs and consumption

Since in rural areas they do not speak English, in order to carry out both interviews and quantifications, there was always a local person who acted as a translator in order to make the communication possible.

3.1. Definition of the study area

The area of study was the village of Bhimpedi. As already mentioned before, Bhimpedi is divided into 9 *wards* (neighbourhoods). The methodology of the study included the quantification of the waste generated by the population of Bhimpedi in selected places of the town, an orphanage and some families. For the quantification of waste generated by families, we focused on the *wards* of Suping (*ward* 7), Chabeli (*ward* 5) and Bhimpedi Bazaar (*ward* 2), as shown in **¡Error! No se encuentra el origen de la referencia.**5. These three wards were chosen to obtain data on the generation of waste in rural areas and in non-rural areas, and thus, to compare them. Waste generation points could be also identified in the area. To carry out the identification it was decided to observe and identify the waste generated in all the wards. The diagnose of the waste management situation in Nepal was also done by talking with the inhabitants and some public institutions.

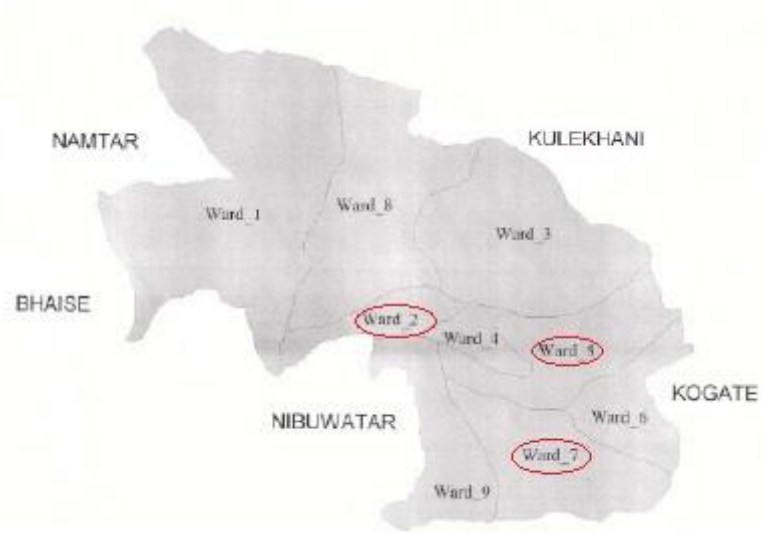


Figure 15. Bhimpedi Bazar (ward 2), Chabeli (ward 5) and Suping (ward 7) on Bhimpedi map

3.2. Identification and origin and of generated waste

In order to determine which inorganic municipal waste were mainly produced, a two-step study was done. Firstly, an unspecific visual observation of the village was done, to have an initial assessment of the expected type of waste produced. Secondly, and mainly to assess the quantity of these wastes, different groups of selected producers were monitored during a period of time; the specific selection of families or business was done according to the advice of Awasuka project to guarantee the accuracy of data collected.

3.2.1. Visual observation of the reality of Bhimphedi

For the identification of the waste generated, the first step was to observe the situation, just walking around the village, through the streets, and observing how waste was managed by individuals and also the mains given to the population by public administration.

On the other hand, we talked with the inhabitants and with people running small business on the village, asking how they do manage their garbage. We also talked with some public institutions such as the hospital and the school.

3.2.2. Specific generators selected

To know the origin of the different types of waste produced in Bhimpedi, a sample of population was determined, considering the limitations that they can imply. According to information given by Awasuka project, some reference points were selected: 14 families of the village (considered collaborative enough for the project), the orphanage, the school, some business (considered collaborative enough for the project), the hospital and the prison. These points were chosen to quantify waste in different areas of Bhimpedi and in different situations. The main objectives were to identify the areas of more and less waste generation, the type of waste is more generated in general and which type of waste is more generated in each point. Also, to identify how is all this generated waste managed in the different situations in the village. The waste generated by these groups was monitored for a period of time of 6 weeks to have representative values.

The people of the villages were distributed as follows. To quantify the waste generated by families 3 wards were selected as reference sites: Bhimpedi Bazar, Suping and Chabeli. The reason was to differentiate between families in rural and non-rural areas, to verify if there was a difference in the quantification of waste generated. Bearing in mind that Bhimpedi is a small village located in a rural area, Bhimpedi Bazar is considered a non-rural area and Suping as a rural area, within the characteristics of Bhimpedi.Fourteen families were selected to carry out the quantification of waste: 7 families in Suping, 4 families in Chabeli and 4 families in Bhimpedi Bazar. Suping is one of the *wards* of Bhimpedi, although some neighbourhood seems like another town (it is an hour walking roughly, mountain up). Suping is divided into three parts: Low Suping, Matilo Suping and Up Suping. Two families in Low Suping and 5 families in Up Suping were selected. Up Suping is more rural than Low Suping. Bhimpedi Bazar is the centre of the village and concentrates all commercial activity. Chabeli is a *ward* located between Bhimpedi Bazar and Suping, although it is very close to the centre of Bhimpedi.

To quantify the produced waste in the different selected points, the producers were asked to separate the municipal waste produced and to keep it separately until it was weighed. To weigh the waste produced an electronic dynamometer was used, which specifications can be observed in Table 1. This method was simple and efficient, and easily transportable to the generation points. The waste was introduced in bags and the bags were hanged in the hook and then weighed. The weight of the bag was considered insignificant respect to the weight of the waste.

	Electronic dynamometer
Product image	
Technical details	
Brand	COLOMETER
Model number	BEIF67
Product weight	99.8 g
Specifications	
Dimensions	11.5 cm * 5.8 cm * 2.3 cm
Capacity	50 kg / 110 pounds
Precision	10 g / 0.02 pounds / 0.3 oz
Waiting reading	Automatic
Power	2 x AAA

Table 1. Technical details and specifications of the electronic dynamometer

To quantify the produced waste in **the families**, they were asked to segregate the waste generated in: plastic, paper or cardboard and glass, and any other fraction of interest. Families were asked to keep the waste at home for one week to be weighed, and after manage it as usually.

Organic waste was not quantified as it was used immediately both for animal feed or to make compost for crops, so they could not keep it for a week.

The methodology to quantify the waste produced in **the orphanage** was similar, by segregating waste into paper, plastic, glass and sanitary waste. Also, every week the amount of waste produced was quantified.

The waste generated both in **the hospital** and **the prison** were not quantified. In the first case because of sanitary risk and in the second because legal requirements. Nevertheless, it is important to consider that they are both generators of different waste.

3.3. Interviews and meetings

3.3.1. Interviews with families

The information searched was structured into different areas, from family data (size, living area….), activities and, questions about waste. Families were interviewed about number of members, working activity, property of cattle and agriculture, and finally, specific questions about type and quantity of generated waste and the usual management. Both families in rural areas and centre of Bhimpedi were selected in order to guarantee a certain quality of results. The information obtained is intended to assess the amount of waste produced by each family. Table 2 summarises the main questions.

Families interview:
Question 1: In which *ward* of Bhimpedi do you live?
Question 2: How many members does your family have? Adults or children?
Question 3: Do you have any animals?
Question 4: Where do the family income come from?
Question 5: What kind of waste generates your family?
Question 6: What do you do with organic waste?
Question 7: How do you manage inorganic waste to eliminate them?

Table 2. Interview to families

3.3.2. Public institutions visits

To collect some information to carry out the project, different public and private entities were visited in Kathmandu, Hetauda and Bhimpedi. The interview content is on Table 3 and Table 4.

In Kathmandu:

- *Amics del Nepal* office
- Clean Up Nepal office. Amod Karmacharya, Clean Up Nepal Executive Director was interviewed. We also had the opportunity to attend the drama (little play) that the Youth Project from *Amics del Nepal* had in collaboration with Clean Up Nepal in a school in the Golfutar district.

In Hetauda, near Bhimpedi:

- Two *kabaddis* (scrap dealers) were visited.

Clean Up Nepal interview:
Question 1: In what year was Clean Up Nepal founded?
Question 2: Who founded Clean Up Nepal?
Question 3: What was the purpose of the creation of Clean Up Nepal?
Question 4: What do you want to transmit?
Question 5: In which areas do you work (towns, cities)?
Question 6: What activities do you do?
Question 7: Do you collaborate with other entities?
Question 8: What is the current waste management in Nepal?
Question 9: How is waste managed in rural areas?
Question 10: Do you have other type of projects?

Table 3. Interview to Clean Up Nepal

3.3.3. Kabbadi visits

The Kabbadis are a place ran by sort of scrap dealers. In this Kabbadis, the producers of waste (individuals or from commercial activities) can bring different waste and sell it. By this way, the waste can be valorised and the producer can obtain certain economical compensation. To fulfil the interviews about the waste management in kabbadis two of them were visited in Hetauda, near Bhimpedi. The questions proposed were focused on type of waste accepted and the price given for each (Table 4).

Kabaddi interview:
Question 1: How does it work?
Question 2: What type of waste do you buy?
Question 3: Can anyone sell his waste here?
Question 4: Is there a minimum amount of waste to be able to sell them?
Question 5: What is done with all the waste you collect? Where is it sent?
Question 6: How much money do you pay for waste?

Table 4. Interview to kabaddi

3.3.4. Other visits

Finally, in the study area, Bhimpedi, some public institutions were also visited with the aim of knowing how the waste generated is managed in these public institutions in Bhimpedi. These other places were:

- The hospital
- The Boarding School in Bhimpedi Bazar
- The Women's Cooperative
- The agricultural Cooperative Agraagami

An interview was conducted in the hospital (Table 5).

Hospital interview:
Question 1: What type of waste is produced in the hospital?
Question 2: How is the waste managed?
Question 3: Is there a collection system for hazardous waste?
Question 4: Is a special treatment used to get rid of hazardous materials?

Table 5. Interview to hospital in Bhimpedi

No interviews were conducted in the other public institutions, we just asked for some information to know how these places worked. In the Boarding School in Bhimpedi Bazar the intention was to prepare some games and activities to raise awareness among children about the importance of having a good waste management.

3.4. Awareness activities

Awareness activities were conducted in the school of Bhimphedi. During our stay, we went to the Bhim Aadhar Community School (Boarding School) located in Bhimpedi Bazar to do awareness activities about hygiene and waste management with children. This activity was promoted by Clean Up Nepal, who informed that main way to achieve the change is through children, because they can absorb all the knowledge and understand its importance. For adults, it was said that try to change old people way of thinking was very difficult, mainly in all these related to waste.

4. RESULTS

4.1. Type of waste and management

4.1.1. Generated waste in Bhimphedi

In the first weeks we observed and identified the different types of waste produced and the main collection points. The first thing observed was that no specific waste management in Bhimpedi was done. There was no collection system or any operator that manages the waste generated by the population. Waste is dispersed through the ground and eventually in some containers.

Figure 16. Planter used as a wastebasket

The identification of the different type of waste generated was done while walking through the wards of Dhorsing (*ward* 1), Bhimpedi Bazar (*ward* 2), Targaun-Simaltar (*ward* 4), Chabeli (*ward* 5), Damar (*ward* 6) and Suping (*ward* 7). The main waste produced were:

- Cardboard
- Plastic snack bags (potatoes, biscuit, etc)
- Water or soda plastic bottles
- Glass bottles
- Cans
- Different plastic containers
- Plastic bags
- Tetra bricks
- Construction bags (big bags)
- Cigarette boxes
- Clothes

All this waste mentioned above were generated by the own consumption of individuals. It should be said that the further we moved away from the centre of Bhimpedi (Bhimpedi Bazar); the less amount of waste dispersed around the streets was observed.

Figure 17. Burned garbage in a concrete planter

The organic waste, such as food leftovers, agriculture waste and pruning waste, is mainly intended for animal feed or used to make compost. The quality of the waste and the product obtained can be questionable, but at least some purpose is given.

In relation to inorganic waste each family is responsible for "removing" their own waste, and we could observe that there are two ways to get rid of these waste: simply throw it through some cliff, the river or, the most commonly, burned.

The water or soda bottles are reused to fill them with water. There is no bin on container in Bhimpedi, planters on the streets are used by some people to throw or burn waste (figures 16 and 17).

Glass is not a common waste found normally on the ground, it is usually managed by retailers in the commerce. When they receive new products they return empty bottles to the distributor, then the company clean and re-fill these bottles.

In general, there is not collection point, nor for organic waste nor for inorganic waste, and waste are dispersed by people, but not a specific point of waste accumulation such as sanitary landfill or even dumping sites. The more usual is to throw the waste in some cliff or in the riverside, which can contribute to pollution of soil and water, and burning in bins or directly on the ground.

The trash burning can be found anywhere in the village and at any time. Each family burns the waste generated and not necessarily when they have a large amount of accumulated waste. In rural areas, given the lack of other sources such as wood or coal, plastic is used as an accelerator for cooking with fire, although they are aware that this practice is healthy unsafe and very harmful to the environment.

Figure 19. Burning waste awareness Clean Up Nepal poster (English)

Figure 18. Burning waste awareness Clean Up Nepal poster (Nepali)

In the case of Bhimpedi, the current waste management is non-existent. In other areas of Nepal, we know that are waste management, in some cities, but quite deficient. In Hetauda, one of the biggest cities in Nepal and the capital of the Makwanpur district, located near Bhimpedi, there are containers and bins to throw away waste all-in-one. There are also a kind of cages where plastic bottles are collected, and there are some big posters asking the citizens to use these facilities for their junk. Due to the number of people there are it is not a city as dirty as Kathmandu.

A study done by three students from medicine, pharmacy and nursing, named before in the section 1.4, shows that in the recent years the diseases related to the respiratory tract have increased.

People must avoid continue doing this practice (figures 18 and 19), but actually and mainly in small villages, burning is the only or the easiest way to get rid of the waste. Other possibilities should consider promotion of landfill from municipalities and encourage people to take measures for health protection (use of gloves and masks) and be aware of the risks of burning waste.

Immediate and long-term health effects produced by pollutants generated by burning plastic:

- Eye irritation
- Respiratory tract irritation
- Asthma exacerbation
- Pulmonary emphysema
- Cancer
- Endocrine disruption
- Spina bifida
- Malformations and neuroconductive disorders

4.1.2. Generated waste in the orphanage

At the time of the quantification in the orphanage there were about 30 children, 3 women caring of the children and doing some tasks such as cleaning, the director of the orphanage, the cooker with its 4 children, and 8 volunteers. The orphanage is located in *ward* 4.

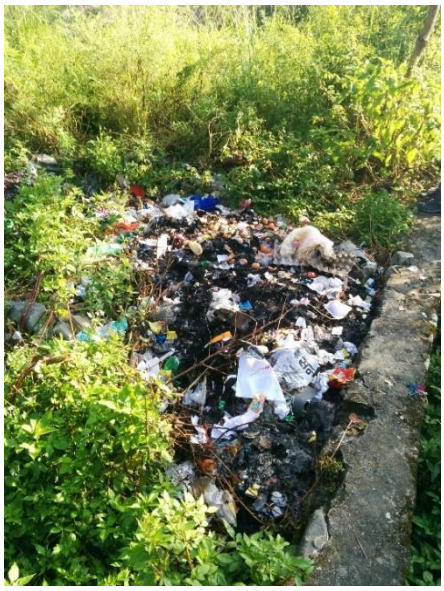


Figure 20. Burned waste in the orphanage

The waste generated at the orphanage is basically plastic (packaging), paper or cardboard, and glass. They have a sort of bins (plastic drums) where they throw the waste collected from the scattered around the orphanage. When bins are full, the waste is pushed to a point that is inside the orphanage facilities, but apart from the buildings (**¡Error! No se encuentra el origen de la referencia.**20), to burn it. Some years ago, they used to burn the waste near the kitchen, between the rooms of the children, but this has change, and burning is done far away from rooms and when a lot of garbage is accumulated. The burned waste includes all kind of residues, from clothes to light bulbs or batteries, anything that goes to the bins are burnt. The food remains are used for animal feed (dogs and hens) and also for composting.

In order to quantify the waste generated in the orphanage, we decided to separate the waste into 4 groups, in those that were generated most: glass, plastic, paper or carboard, and sanitary (plasters, cotton, gauzes, sanitary towels, medicines packaging, etc.). We placed in the orphanage some containers with posters and explanations with images so that the waste was separated easily for the subsequent quantification (**¡Error! No se encuentra el origen de la referencia.**).

Glass was only generated in the kitchen, mainly composed by reused beer bottles refilled with tomato sauce. Once the bottles are empty, they do not know what to do, they do not want them anymore, and tend to accumulate them in the orphanage. They also generate some glass jar that is reused when they make some canned food, such as jam.

Figure 22. Segregation waste explanation

Figure 21. Plastic and paper buckets

To improve the separate collection of waste, some buckets were bought (**¡Error! No se encuentra el origen de la referencia.**22). Plastic and paper buckets were placed near the entrance of the kitchen / dining room and between the two room modules of the children. A poster with drawings was put explaining in a visual way in what way waste must be segregated. In the office, where there was the medicine kit, a bucket was placed to throw away sanitary waste.

It should be said that the results obtained from the quantification of the orphanage were not 100% real or reliable, because the results should be a little bit higher. Women who take care of the children and do some of the tasks, such as the cleaning, they used to empty bins and carry the waste to burn it, as a routine and

part of their job, although we told them that a project was on going and we were assuming the responsibility of this task.

The waste quantification in the orphanage was done for 6 weeks and result are shown in Table 6.

WEEKLY WASTE QUANTIFICATION			
	Plastic (g)	Paper / Cardboard (g)	Sanitary (g)
Week 1	180	555	35
Week 2	780	415	225
Week 3	1425	455	160
Week 4	2185	695	175
Week 5	550	420	415
Week 6	1275	485	80

Table 6. Weekly waste quantification in the orphanage

In order to infer the amount of waste produced during a month, only the 4 last weeks were considered because the 2 firsts were used as adaptation period to the segregation of waste practice.

The plastic generated in the orphanage is basically composed by bottles, bags, shampoo bottles, toothbrush and wrap. Paper waste is composed of scraps of paper, newspaper, some cardboard box and various paper. In the case of sanitary waste, medicine empty bottles such as oxygenate water bottles, used gauzes, cotton, plasters, tissues or ear sticks, among others are the main. They do not produce the same quantity of waste every week, it is quite irregular especially in the case of plastic. The cause for this difference could not be defined.

Regarding to glass, glass bottles (beer bottles which contains sauce) are generated approximately 8 or 9 units per month and in the orphanage do not know what to do. Glass jars are also generated end they reuse them when they make jam, as they are reused, they are not quantified as waste.

Table 77 shows the estimation of waste generated in the orphanage by people living in. As a general results, it can be observed that plastic is the most generated waste, and sanitary waste the least generated. nevertheless, the consideration of total amount of waste for people living or using the orphanage is very low.

TOTAL WASTE ESTIMATION FOR 1 MONTH	
Plastic	2.055 kg
Paper	5.435 kg
Glass	4.230 kg
Sanitary waste	0.830 kg
TOTAL	12.550 kg

Table 7. Total waste quantification in the orphanage in a month

Considering the people in the orphanage (about 47 people) and total production (12,55 kg), means an average of 267 g per person, and then 8,9 g per person and day is expected. These values are very different from those that can be found in an area as Catalonia, were about 1,35 kg/person/day of municipal waste are generated (ARC, 2017). As not quantified in this study, organic waste can be an important part; but as above mentioned, another important part can has been burned before quantified.

4.1.3. Waste generated by families

The quantification of the waste generated by some selected families was complicated, at the beginning they did not understand what we were asking for, and they expected something in return for their help, such us money or some kind of compensation. The first weeks we told them to keep the waste generated in order the quantify it weekly to assess the waste produced in a family by a month. Some families did not understand what we were asking for, others simply told us that they could not keep their waste because, for example, plastic waste is used as an accelerator to make fire to cook. Although being aware that is not good for health, they consider that it was better to take advantage to burn it for cooking rather than burn it anywhere else.

Figure 24. Waste quantification

Figure 23. Family interviewing

Families had to segregate the rubbish they generate every week, but the reality was, in some cases, that they kept all the waste together in the same place and then we had to separate it to carry out the quantification.

Table 8corresponds to the results obtained from the family interviews, following the questions that can be found in section 3.3.1. Most of the families in rural areas were dedicated to farming (crops and animals). Some of the selected families had small business.

	Ward	**Family members**		**Animals**	**Occupation**
		Adults	Children		
FAMILY 1	Up Suping	3	3	1 buffalo	Agriculture
FAMILY 2	Up Suping	3	-	Goats	Agriculture
FAMILY 3	Up Suping	2	-	1 buffalo and goats	Agriculture
FAMILY 4	Up Suping	1	-	-	Agriculture
FAMILY 5	Up Suping	2	2	1 cow, 1 buffalo and goats	Agriculture
FAMILY 6	Low Suping	3	2	1 cow, 1 buffalo and 9 goats	Agriculture
FAMILY 7	Low Suping	4	2	2 buffalos and 2 goats	Small shop of drinks and snacks
FAMILY 8	Chabeli	2	3	1 dog and chickens	Agriculture
FAMILY 9	Chabeli	3	-	1 dog	Small shop
FAMILY 10	Chabeli	4	2	1 dog	Agriculture
FAMILY 11	Chabeli	3	-	-	Agriculture
FAMILY 12	Bhimpedi Bazar	4	-	1 dog	Stationery
FAMILY 13	Bhimpedi Bazar	2	-	Goats	Ranching
FAMILY 14	Bhimpedi Bazar	3	2	1 dog and 1 goat	Small food business

Table 8. Quantification of the waste generated in a month by families

During the interviews, it was also asked about the waste generated by the families and how they manage and "eliminate" this waste. The waste produced by families is, basically, plastic and paper, and organic waste, from the remains of food and crops. Some families also generate, in less quantity, glass, metal and clothes. In the results of the quantifications (Table 9), it can be observed which material is the most generated and if there is a difference in the generation of waste according to the area in which the families live.

Most of the families have crops and animals, so organic waste is used for animal feeding and to produce compost for crops. The food remains are basically rice, lentils and other vegetables from *dalbhat*, the basic food dish in Nepal. The main way to manage the waste produced is burning. Some families, although in lesser proportion, just throw the waste anyway. Some of the families in rural areas burn plastic residues as an accelerator to make fire to cook.

In the case of families in rural areas that generate little waste they burn it collectively every few days.

Household waste was quantified for 5 weeks, to calculate the waste generated in one month, the data for the last 4 weeks have been used.

WASTE QUANTIFICATION (1 month)							
	Members	Plastic (kg)	Paper / cardboard (kg)	Glass (kg)	Metal (kg)	Clothes (kg)	kg/person
FAMILY 1	6	0.500	0.445	5.170	-	-	1.019
FAMILY 2	3	-	-	-	-	-	-
FAMILY 3	2	-	-	-	-	-	-
FAMILY 4	1	0.325	-	-	-	-	0.325
FAMILY 5	4	0.165	1.330	-	-	-	0.374
FAMILY 6	5	13.003	-	22.707	0.435	4.660	8.161
FAMILY 7	6	-	-	-	-	-	-
FAMILY 8	5	2.710	1.220	-	-	-	0.786
FAMILY 9	3	5.945	4.833	-	-	-	3.593
FAMILY 10	6	3.065	1.183	-	-	-	0.708
FAMILY 11	3	-	-	-	-	-	-
FAMILY 12	4	2.400	4.230	-	-	-	1.658
FAMILY 13	2	0.385	0.175	-	-	-	0.280
FAMILY 14	5	0.985	0.730	-	-	-	0.343

Table 9. Total waste quantification generated by some selected families in kg

Observing the data resulting from the quantification of the residues generated by the families during a month, the most generated residue is the glass, followed by the plastic. The less waste that is generated are clothes and metal. However, the data obtained is not sufficient to draw conclusions. There are few data and, in some cases, the data are not well taken.

At the time of quantification, some families gave us the same waste each week to quantify, they had a bag with some waste and every week, it was the same with the same weight and the same waste. Other families did not keep the waste to quantify, as in the case of families 2, 3, 7 and 11, every week they told us that they had forgotten to keep the waste.

Considering the generated waste by person, results widely vary for each family, from production of 300 g per person (Families 4, 5, 13, 14) up to 8 kg (Family 6). These differences can be attributed to different familiar status and to the conscientiousness to collaborate with the project.

Although the quantifications are not conclusive, the residues generated by the families were the following. The plastic waste generated was, especially, containers of plastic of oil, plastic bags, plastic bottles and wrappings of snacks and cookies. For the glass, many families did not keep them because culturally, in Nepal, it is not well seen to drink alcohol, and mainly the glass waste is of bottles of beer. Regarding the paper, the residues observed were newspapers, some cardboard box or notebook, and torn papers.

What is observed is that rural areas generate less waste than in non-rural areas, it is due to lifestyle, since there is no commercial activity in the rural area (or it is very little), the amount of plastics and waste in general that are generated are minimal, in addition, they usually reuse some materials such as plastic bottles or glass jars to store water or food.

In order to make a correct quantification of the waste it would be necessary for the quantifications to be made over a longer period of time and to choose the most number of families to take data, taking in place that some have to be eliminated because data have not been obtained.

4.1.4. Generated waste by business

These business refer to small shops or places to eat something managed by families in the town. This small business also generate waste, and the usual practice is to burn it, with the exception of some things as glass bottles of soft drinks such as Coca-cola, Fanta or Dew (Nepalese soft drink) that are kept to return them to the company to be cleaned and refilled to sell them again. Some stores also keep plastic bottles and cans, and every one or two months, somebody from Hetauda comes for this waste and gives some money to the

owners of the shop (about between 1 or 3 rupees per piece). The rest of waste they produce, such as plastic bags, packaging, paper or carboard, is just burned.

One of the owners of a business in Bhimpedi ask the citizens to bring empty plastic bottles, so he can take profit on it and people do not burn them or throw it away.

4.1.5. Other generated waste

There were other places in the village as the hospital, the prison or schools (there were more than one) that generate wastes, although we did not quantification waste in that places.

In the case of the hospital, waste was not quantified as there were hazardous materials, like biological remains and materials in contact with sick people, but we asked where the residues went. The instruments they use are well disinfected, as they said, they have a process of disinfection and sterilization of the instrumental very careful, and then they use it again. The material such as gauzes, cotton, towels, etc.; everything that cannot be exploited and does not have any other utility was burned outside near the hospital. And, finally, all the waste coming from the human body, such as organs or blood, is put in a hole of 2 meters deep and they expect it to degrade, and when a hole is full they cover it and simply make another one. It was not a large hospital, rather a health center, that serves patients who can afford it financially.

Waste generated in schools were not quantified, since they were minimal, only some snack packaging from children lunch. Some of them brought their food in a lunch box, so not a lot of waste was generated. Awareness-raising activities on the importance of good waste management and correct hygiene were carried out in one of the schools.

A lot of inorganic waste is also generated in Bhimpedi prison. Currently there are about 600 prisoners, twice their capacity. Jailers are also living in jail facilities with their families. In Bhimpedi prison, the way to get rid of waste is also burning it, once every two weeks approximately. A large fumarate resulting from burning waste, for two or three days, causes a gray fog as a consequence of this burn that surrounds Bhimpedi. The residues of the prison were not quantified either.

4.2. Current management

In Kathmandu, the capital of Nepal, waste is crowded in the streets in any way, there is no kind of bins or containers where citizens could throw their junk, so they just throw it away anywhere. This is why it is a dirty city with so much garbage accumulated in the streets of the city and also in the river that crosses it. Once a week, approximately, a truck removes part of that waste and take it to a landfill or to a different place to burn it.

Currently, Sisdole landfill is reaching its maximum capacity. The rapid and unplanned growth of the Kathmandu Valley, deficient municipal management and the absence of elected mayors for 20 years make the problem of garbage a chronic crisis. The increase in plastic and the failure to recycle biodegradable waste, which constitutes more than half of the garbage, worsen this situation. The main cities of the Kathmandu Valley have never developed an integral waste management system that goes beyond simply collecting and disposing of waste.

The proposed site as an alternative to the Sisdole landfill is Bancharedanda, located on the border of the Nuwakot and Dhading districts, and it will have the capacity to handle the waste from Kathmandu for 50 years. The government acquired 90 hectares to carry out the project, and it is estimated that it will cost 3 billion rupees. Experts say that Kathmandu first need to think about an alternative to Sisdole landfill in a short term to avoid the imminent emergence of garbage. But more in a long term, it is time to think about integrated waste management within the framework of the new local governments.

Incipient garbage companies, such as Doko and Khalisisi, started by young Nepalese social entrepreneurs, also fill the gap in waste management left by the government and municipal negligence. One of this companies is Dokorecyclers, a company dedicated to the recycling of waste produced by individuals. When someone has accumulated waste, segregated, they come home to collect them and pay some money. They are the first digital platform for recyclable waste collecting in Kathmandu for households. They also offer personalized recycling services for large housing societies.

They say that hey offer previous, fast and trouble-free collection. They also offer some containers to collect all the recyclable waste in one place. If someone does not want to make money by recycling their waste, they can donate the money that they would earn with their junk to any association or NGO.

At the moment they only work in Kathmandu and surroundings, and they collect many types of waste: magazines, cartons, egg cartons, old books, paper bags, paper boxes, mixed paper, toilet roll cardboard, toothpaste cover, beverage bottles, bubble wrap, plastic bags, cosmetic bottles, toiletries, mixed plastic, milk packets, water bottles, plastic furniture, gas regulator, beer bottles, jam bottles, glass bottles, aluminium foil and containers, deodorants, drink and food cans, paint cans, aluminium, pipes, mixed metal, stainless steel and even electronic waste such as computers, mobile phones, cables or electronic equipment.

Scrap dealers are people who brought or collect scrap and then sell it for profit. So, there are some sites called *Kabaddi* (recycling dealers), which are like a kind of waste collectors or scraps dealers. They buy some types of waste, such as plastic or glass bottles, paper, cans, iron or other materials. They work in cities and there are different types. At Hetauda we were able to visit a couple of kabaddi and talk to the people who ran them.

Figure 25. Kabaddi (scrap dealer) in Hetauda

In the **¡Error! No se encuentra el origen de la referencia.** it can be observed one of the *kabaddi* visited in Hetauda. When they have a large amount of waste, they bring it all to Borunj, near India, where they pay a quantity for these waste, which destined to the production of energy.

Individuals can exchange their waste for money, as long as kabaddis are interested in this type of waste also. There are many types of kabaddi, some of them only buy a type of material, for example, a kabaddi that only buys metal. They buy some materials for pieces and others for kilograms. Each kabaddi has they own rates. There is no minimum quantity of waste to sell, but it would not make sense to make a bus trip, for example, to sell a couple of plastic bottles, since with the gains of the sale won't afford even the bus ticket.

During the past few days in Bhimpedi, an initiative to recycle clothes was discovered. It is a machine that cut the clothes in very small pieces; and these small clothes pieces are used as mattress filler. In **¡Error! No se encuentra el origen de la referencia.**6 can be observed the operation of this rudimentary machine. They introduce the clothes on the right side, where several blades chop the clothes, similarly to shredder for paper. In the other side of the machine, clothes come out already cut, like a kind of fluff, and are stored in a big cloth bag.

Figure 26. Recycling clothes machine in Bhimpedi

People can take advantage on the clothes they have in disuse and sell them, instead of burn them or throw them away. The rate is about 30 rupees for each kg of clothes.

Approximately once a month, the machine is taken to Bhimpedi, and also they go to Suping (one of the most rural areas in Bhimpedi).

Figure 27. Resulting mattresses

In **¡Error! No se encuentra el origen de la referencia.**27 can be observed the resulting mattresses, stuffed with the stitched clothes.

4.3. Interviews

Below are the interviews that were carried out in some public institutions, as well as some meetings with other entities or people of interest.

4.3.1. Clean Up Nepal interview

We moved to the Clean Up Nepal office in the Golfutar district in Kathmandú. We talked to Amod Karmacharya, Executive Director of Clean Up Nepal. The interview followed the questions in section 3.3.2, although it took different forms as it progressed.

Dr. Neelam Pradhananga realized that a continuous movement of cleaning was needed to achieve a change in behaviour, a positive movement that embraced and provided a common platform for individuals, communities and organizations working in the environmental sector to prepare programs and events that help to clean some areas and thus end up with the endless piles of junk found in the streets.

Clean Up Nepal began working in Nepal in January 2013, started with cleaning activities every week and they keep doing it. In the process, the hearts of many communities and neighbourhoods have been won. This organization is registered as non-governmental and non-profit.

They have an office in Kathmandú that coordinates and supervises all the programs and projects that they have in Nepal. They are a small group of committed and dedicated volunteers with occasional program staff.

Clean Up Nepal works in partnership with organizations that are committed to achieving social change, because they believe that a collaborative and creative approach is needed to deal with the most difficult problems in the world. Its partners include the private sector (including small, medium, and multinational organizations), academic institutions, foundations and trusts.

This NGO has worked for three years in Kathmandú capital and in some cities around to improve waste management through the collective awareness and inhabitant cooperation, since it is an improvement in the well-being and quality of population's life.

They do not work in towns, for the moment they have only focused on the cities. What they do is to go to schools trying to educate children, because children are not well trained in this area and at this age is when more knowledge and information is absorbed. What they do is a kind of representations that educate very visually in the proper management of waste and the consequences of burning them, in these plays participate a group of young people from the Youth project from *Amics del Nepal*.

Figure 28. Youth from Amics del Nepal representing the play in a school

The Youth project consists of a group of Young people sponsored by *Amics del Nepal*. Children of poor families and without resources that Amics del Nepal pays for their studies and they, in return, collaborate with them in a kind of social centre for young people. There they can take computer lessons, learn Spanish and other activities. They also have another project in which they represent a play, very visual and easy to understand, about waste management. They go to schools and represent this play where they explain that it is not good to throw waste anywhere or burning it and the consequences of doing it, so they do in a fun and dynamic way, so it is much easier to reach the children and they can absorb all this knowledge. After they play they to some workshops so that the children can demonstrate if they have understood or not what to do with each residue and the consequences of each action regarding the junk. For example, they have a huge body draw where children can put in the organs the diseases that a not correct waste management can produce; they also have a game that is a kind of quiz where children earn points if they answer some questions correctly.

Figure 29. Plastic packaging crafts

They consider that the biggest problem are the snack bags (plastic), and that there is no option to recycle them. The only solution they give us is to make crafting with this plastic. To do this, this snack bags should be collected, cleaned with soap and let them dry, and then make a kind of boxes or plates. They tried to sell it to have some extra money, but nobody bought it, so they want to encourage people to use it at home in everyday life.

One of the many other projects they have in Clean Up Nepal is to adopt a tree (Green Up Nepal), they planted trees with some volunteers, but the problem raised was that after planting them, no one took care of them, so only survived around 2-3 % of the trees that were planted. For this case, compost produced from the recycling of organic waste could be used for this purpose.

Another thing that Clean Up Nepal is working on is the creation of an interactive website that shows the routes of the trucks that collect waste, where they take it and where they go with this waste, but is still not working. For the moment they are trying to do it with Kathmandu city only.

They believe that is very difficult, if not impossible, to change this situation in towns and the more rural areas. A waste that could be appreciated in towns are bottles and plastic bags, since there are places where those waste could be sold if you take a large quantity.

4.3.2. Rotary Club. Meeting with Ram Prasad

We met with Ram Prasad Sharma, a member of the Hetauda Rotary Club, to ask for his help in our project. We explained the situation we observed, about the waste generated, the *kabaddis* of Hetauda. We also asked for the possibility of hiring a vehicle to transport recyclable waste from Bhimpedi to some Hetauda *kabaddi*, the cost and the self-managing of the activity. We expected to cover the expenses with the gains of the waste sales. In this way, the city council or the citizens would not have to put money to manage their waste.

Figure 30. Glass beer bottles

Figure 31. Kabaddi in Hetauda

He took us to a *kabaddi* to talk with the owner. They bought waste such as glass bottles, paper and cardboards, notebooks, plastic, iron in general (scrap), books, paint cans, etc, but they do not buy light bulbs or batteries.

What they considered was the interest in collecting the waste generated in Bhimpedhi. In that case they could go to Bhimphedi under alert to collect the waste and load a truck for free but they won't pay anything in exchange.

So the next step was to know if there would be any space where the waste could be deposit in Bhimpedi, and investigate the way that it could work, maybe some operators are needed, inhabitants collaboration to bring the waste to a common place, government support, etc.

4.3.3. Meeting with the mayor of Bhimpedi

We met with Mr. Hidam Lama, Mayor of Bhimpedi at the time of the study. The last week of our stay in Bhimpedi there were elections and we do not know if there has been a change of mayor.

We explained the reason of our study in Bhimpedi, and we asked him if it would be possible to have a space in Bhimpedi where the waste generated by the population could be accumulated. In addition, this space should be managed by a person that must control that everything is clean and when there is enough accumulated waste, to call someone who should come to pick it up. This worker should receive a salary for doing this work, and this salary would be assumed by the government.

We gave him the results we had until the time we talked with he and our proposal, so they can think about it. They told us that some time ago they were planning to put containers in Bhimpedi bazar to collect the waste generated by the inhabitants.

One day we saw the police and the army cleaning the main street of Bhimpedi (Bhimpedi Bazar), with garbage bags and sticks collecting the garbage accumulated in the streets, to burn it later. We were told that it was the first time they did it, and the idea is continue doing it from time to time. Later we realized that the garbage collected from the streets was a campaign for the elections that were approaching.

4.4. Awareness activities in the Boarding School of Bhimpedi

The explanations were always taking into account that we were not in our country, adapting ourselves to cultural features and ways of doing that are not the same we have in Catalunya. For example, the real situation of waste segregation system and, in terms of hygiene, considering certain aspects as in Nepal they do not use paper to clean themselves after going to the bathroom and do not use cutlery to eat, they do it with their hands.

The distribution of students by classes in the school comprehends 6 levels. Students are split by knowledge instead of age, and range of age covers from 3 to 14. The younger use to be in lower levels while the older in higher. Nevertheless some of the older students can be in lower levels.

The activity was distributed into three different days. The first day was a hygiene activity with the students in the higher levels. The second day was a hygiene and waste management activity with the students in lower levels. And the third day, the last one, was a recycling activity with the students in the higher levels again.

4.4.1. Activity "*I like hygiene*"

The first day we went to the school we started doing hygiene activities with the three bigger classes of the school. We spent about 40 minutes on each classroom, starting with a small introduction explaining what hygiene is, why it is important and which habits we must do to stay healthy and clean.

The main topics tackled in this activity are summarised in Table 10, splitting in justification and the mains to achieve the goal.

WHY	These habits are very important to stay healthy and clean! Otherwise we can be sick because of bacteria entering in our stomach and causing diarrhoea or vomits. Or in our respiratory system and make us cough and sneeze for days, and even causes fever.
WHO WANTS TO BE SICK? NOBODY!	If we are healthy we can play with our friends and do a lot of things we like. Also, if we learn to stay healthy and clean when we are young, later we will be strong and happy adults.
HOW	1. Wash our body regularly. 2. Wash our hands with water and soap before and after eating, after touching animals, after going to the toilet. 3. Brush our teeth 2 or 3 times a day. 4. Sleep the necessary hours (if we rest then we have more energy and we will do things better).

Table 10. Main topics of the activity "I like hygiene activity"

Figure 32. Playing a Pictionary version

After the small introduction, with the two classes where were the oldest children we played a version of the famous game "Pictionary" in which there were three colour cards: yellow, blue and brown. The brown cards were mimics, those of blue colour were drawing, and those on yellow colour to define a word without saying that word that appeared on the card. We divided each class into two teams, and every boy or girl had 60 seconds to represent what was in the card, so their colleagues could understand and guess the word, always related to hygiene. It was very dynamic and fun (**¡Error! No se encuentra el origen de la referencia.** 32).

In the last class, where the children were smaller, we did the same theoretical introduction, but instead of doing the Pictionary game, we went outside and played games that we adapted so they have some relation to hygiene:

- INFECTED / NOT INFECTED GAME. It is similar to "pilla-pilla" game, but three children of the group are bacteria, the rest are running to prevent them from touching bacteria and being infected. If a bacteria touch an uninfected child, this child becomes ill and must remain quiet until one of their

uninfected friends touch them so they can run again. The game ends when all children are infected (**¡Error! No se encuentra el origen de la referencia.**3).

- BACTERIA GAME. There is a line drawn on the ground where a child is placed, who is the one who catch the others, the bacteria. The rest must cross this line without being caught. Whoever is caught also becomes bacteria, and there are more and more. To take the rest, they must go hand in hand and always have a foot on the line. The game ends when everyone has been caught (**¡Error! No se encuentra el origen de la referencia.**4).

Figure 33. Playing infected / not infected game

Figure 34. Playing bacteria game

4.4.2. Activity "*I like recycling and hygiene*"

On the second day we went to the school and we made also an activity about hygiene but this time with the three other classes, with the little children. We started with a small explanation about hygiene and the habits to be healthy and clean. After, we gave them some draws related with the explanation to colour them; these pictures could be taken home (Figure 35). In those classrooms the teacher helped us on translating because there were a lot of little children who do not understand English yet.

Figure 35. Colouring some draws about hygiene and waste management

4.4.3. Activity "*I like recycling*"

On the third day we went to the school, we went again to the three classes that had the older children. This time we made a brief explanation about why waste management is important.

WHAT DO WE HAVE TO DO WITH OUR WASTE?	What waste do you produce? Food remain, plastic, glass, paper, cartoon, sanitary waste (which kind of sanitary) Throw this waste on the street produce water and soil pollution, and this is not good for the environment, also we must try that our city looks nice. Also burning this waste is not good, it produces air pollution and this is not good for our health. We also talked about the consequences of burning waste with the help of Clean Up Nepal posters. Persistent pollutants that we incorporate into our bodies by breathing this polluted air, once they enter, do not leave, and are precursors of cancerous diseases.
WHAT WE CAN DO?	Segregate the waste that we produce, so if we take profit of the organic waste and we can recycle or reuse other materials, then we can reduce the amount of waste that goes to landfill.

Table 11. Main topics of the activity "I like recycling"

To do this in a more dynamic way we played a game in which we split each class into two groups and distributed some drawings of all kinds of waste, so they had to decide where to place each residue (**¡Error! No se encuentra el origen de la referencia.**). We have previously explained how to separate garbage, the types of waste that go to each place. In each country waste segregation works in a different way, for example, in Spain we separate organic, glass, plastic and paper, but in Nepal they do it in a different system, so we adapt the game to the way in which they separate garbage:

- Organic waste. Food remains that can be used for animal feeding or for doing compost.
- Recyclable materials. Plastic, glass, paper and cartoon. Most of these materials can be brought to a "kabaddi", in big cities, where the waste is collected so don't need to burn it.
- Landfill. All the waste that we cannot use again, like sanitary waste (plasters, patches, needles, diapers, etc.)

Figure 36. Waste segregation game

We also explained them the consequences of burning waste and we made a game in which the children had to place some of the diseases caused by the toxic gases of junk burning in a human body, which disease could cause in different parts of our body (**¡Error! No se encuentra el origen de la referencia.**7).

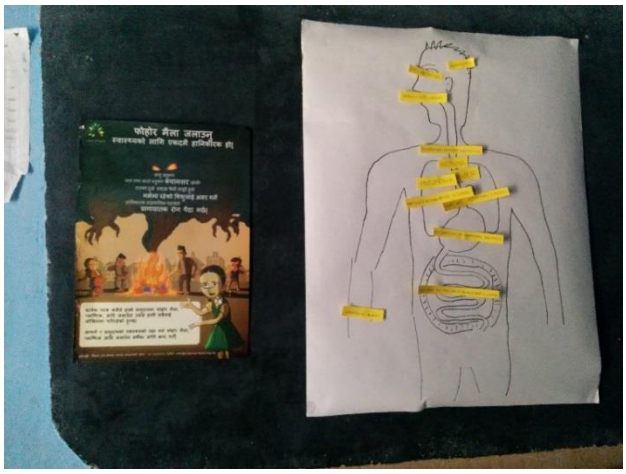


Figure 37. Consequences of burning waste game

We know that in rural areas it is very difficult to change old people's way of doing. We told them not to burn waste, but if it is the only way they have to manage waste (there is no one who pick up the waste or there is no nearby poultry), and the way they are used to. So, we proposed to better take precautions and burn waste in a most safely way, such as:

- Bury everything and throw lime and ash on top.
- Put on gloves and masks while burning.
- Isolate the burning area, with stones, for example, to prevent a fire.
- Not stay close while waste is burning, because sometimes they sit around just to have some heat.
- Do not cook using plastic as an accelerator.

4.5. Presentation of the Project at the Kathmandu Rotary Club

On December 12, 2017, part of the present study was presented to the Kathmandu Rotary Club in the Shanker Hotel in Kathmandu (**¡Error! No se encuentra el origen de la referencia.**).

Rotary International is an organization and service whose purpose is to bring together business leaders and university and non-university professionals, in order to provide humanitarian services in their communities, promote high standards of ethics in all occupations and contribute to promoting goodwill and peace in the world. First Rotary Club was organized in Chicago. At present, there are more than 33,000 Rotary Clubs in more than 166 countries in the world.

The motivation of this study in Bhimpedi was presented in front of some members of the Kathmandu Rotary Club, as they are a group of people with contacts and resources that could help. The existing problem was exposed, besides some proposals and alternatives to try to improve this situation. They agreed on the importance of a good waste management, which has an impact on the quality of life of the inhabitants, influencing both their health and the environment.

Figure 38. Ainoa, Maria, Daylí and Mònica (from Awasuka) with some of the members of the Kathmandu Rotary Club

If in the future, the proposals and alternatives of the present project for the improvement of waste management in Bhimpedi are carried out, the members of the Kathmandu Rotary Club will help as much as possible.

5. PROPOSALS AND ALTERNATIVES

Based on the study (about waste management) realized in Bhimpedi, the analysis of the real situation has been carried out, identifying an important part of the existing problems in the current waste management.

Information of interest related to waste and its management has been compiled, and taking into account the objectives of the present study, different proposals and alternatives have been evaluated. The reality of Bhimpedi and the needs expressed by the local population were considered before drawing up future alternatives, in order to ensure the viability of the projects.

In general, it is considered necessary to establish relationships with a non-governmental organizations to assume the role of local stakeholder for supervising, guiding and controlling the projects, particularly at the beginning.

5.1. Study of the determining factors

This section aims to identify those factors that cause the target situation. This helps to establish the premises to undertake proposals or alternatives to current waste management situation. Some of these factors are summarized below.

5.1.1. Geographic characteristics

Bhimpedi is located in a mountainous area, and its centre ward is located at height of 1150 meters in a valley surrounded by two rivers. The rest of the wards are distributed surrounding the center of Bhimpedi, in more mountainous areas. These features can limit the transport of the waste to centralise the management, the construction of facilities for waste management (treatment plants, landfill…). Also shall be considered the climate with monsoon season with high precipitation.

5.1.2. Communications

Regarding the communication means, not only in Bhimpedi, generally in all Nepal, during the period in which this study was conducted, the state of the roads was quite precarious, largely due to the earthquake that took place in May of 2015. They are usually narrow and unpaved roads.

The main roads to Bhimpedi are:

- Hetauda Bhimpedi road (23 km)
- Bhimpedi – Kulekhani – Fakhel – Kathmandu (53km)
- Bhainse – Bhimpedi – Chitlang – Thankot Road (Ganesh Man Singh Road)

The Tribhuwan Rajpath highway communicates Hetauda and Kathmandu.

Due to the state of roads, distances are not calculated in kilometres, they are calculated in hours. To go from the centre of Bhimpedi to Hetauda by bus and travel a distance of 20-25 km, it is estimated between one hour and a half and two hours. From Bhimpedi to Kathmandu, the journey can take between 3 hours and a half and 5 hours on a jeep (4x4 car), depending on the traffic and which of the two available roads is used. By bus it can take more.

This situation hinders the transport of waste and access to landfill sites. Access to some of the Bhimpedi wards is through mountain roads, where vehicles do not have access or is in a somewhat restricted access.

5.1.3. Government

For the implementation of an efficient waste management system, the role of the government needs to cover both economic and legal issues, as subsidies and regulations, respectively. The government is aware of the importance to support waste management and the effort entailed but at the end of the day it seems not to be a priority.

Government in Nepal is affected by low stability in political posts[3], corruption[4] (both in politicians and people). The corruption increase in Nepal is attributed in large part to the abuse of power by public officials for personal gain. Before May 2013, the worrying on state corruption were attributed to the lack of a Commission Against the Abuse of Authority (CIAA), provided by the Constitution. But, even with the creation of the monitoring management, things did not improve. The same CIAA was involved in numerous scandals about the commissioners who received bribes.

The government banned the use of plastic bags multiple times, but the rule was never properly implemented because scant homework was done to give consumers alternatives. Plastic industries, which benefit from political patronage, say they were never consulted.

"Political parties get donations from plastic manufacturers for election campaigns, so the bans are never seriously enforced," explains Dipendra Oli of the Solid Waste Management Technical Support Centre. "Who do you think they will listen to: environmentalists like us or the manufacturers?"

5.1.4. Social and cultural features

In Nepal everything goes more slowly. It could be said that Nepali people are conformists and happy with what they have. When making any changes it is difficult to work. If they have to make some effort, even for its own sake, they ask for something in return, like money or some compensation. For this reason is difficult to carry out some kind of projects in this country.

5.2. Short-term proposals and alternatives

5.2.1. Protection measures during burning of waste

Since the practice of burning the waste generated is deeply rooted, especially in rural areas, and that sometimes it is the main option, sensitizing on use of masks and gloves should be promoted for health prevention. In the long-term this will contribute to reduce respiratory problems and irritation of skin and eyes.

Another measure should be avoid standing beside the waste bonfire and make the bonfire as remote as possible, away from houses in order to avoid toxic and harmful gases as much as possible.

5.2.2. Use of charcoal to cook

Another practice they use, especially in the more rural areas, is to cook burning wood, coal, manure or agricultural waste, and sometimes plastic waste is used as an accelerator to make the fire to cook. This produces a smoke with a variety of irritant pollutants, some of them carcinogens. The cooking fire is made inside the houses, where there are not chimneys or windows to evacuate the smoke. Women and children are those who are the most exposed.

The use of charcoal from agricultural waste can be an alternative. This vegetal charcoal as briquettes can be produced by pyrolysis of corncob and be economically profitable. This will reduce the risk for health, improve the environment and provide a constant and renewable resource, as well as contribute to reduce deforestation. This alternative will need a small investment and manufacture can be done with local materials and cheap production methods.

A business vision could be tackled to produce these briquettes by a cooperative system training interested people and, at the same time, these people could train others to share this with more people.

[3] In three decades there have been 25 different governments. In the last 11 years, 10 prime ministers

[4] According to Transparency International (TI), the country is ranked 143 among 181 countries on its scale of anti-corruption

5.3. Long-term proposals and alternatives

5.3.1. *Kabaddi* transfer from Bhimpedi to Hetauda

The first long-term proposal would be the implementation of a suitable space in Bhimpedi for the collection of recyclable waste such as glass, plastic, paper and carboard, metals and cans. To be transported to Hetauda when the quantity is enough to fill a truck, as explained in section 4.3.2.

In order to carry it out, it is first necessary to have space enough to store the waste. This area should be covered to avoid excess of waster in rainy season. The inhabitants of Bhimpedi could take their waste separately to this point to be transferred to Hetauda. This kabaddi will need of an operator to keep the waste ordered and segregated and call to kabaddi Hetauda to collect the waste when the quantity is enough to fill a truck. In rural areas this truck could be able to collect waste once a month, every two months or every six months, depending on the time it takes to accumulate a considerable amount of waste.

The *kabaddi* from Hetauda would not pay for the waste collected, but would assume the cost of transporting them to Hetauda. Bhimpedi and its inhabitants would not get economic benefits, but it would be possible to reduce significantly the amount of waste that is burned or thrown away but will contribute positively to a better waste management. This is one of the ideas that Clean Up Nepal try to promote with its campaign (**¡Error! No se encuentra el origen de la referencia. ¡Error! No se encuentra el origen de la referencia.**).

Figure 40. Waste awareness Clean Up Nepal poster (English)

Figure 39. Waste awareness Clean Up Nepal poster (Nepali)

For this to work, people from the town should collaborate by carrying their waste. Although they would not receive any reward; in a long-term, the benefits would be in health and environment.

In this case, the Bhimpedi city council should be in charge of providing the necessary space and covering the cost of the salary of the operator that would be responsible for the correct operation of this space.

5.3.1. *Kabaddi* Bhimpedi

Another proposal would be that Bhimpedi had his own *kabaddi* as an evolution of the previous proposal. A covered space would be needed to accumulate the waste of the town as well as an operator to run the *kabaddi*. By the system the waste collected could be sold directly to a company in India, as Hetauda *kabaddis* do.

Paying the cost of the truck to transport the waste with the profits resulting from the sale of the waste. It should be known how much costs the transport with the truck and if it really would be worth it. It would be good that it could be self-managed.

A small truck could move from time to time to collect the waste in furthest *wards*, where some containers could be disposed to collect waste by inhabitants.

As in the previous proposal, the city council should provide the appropriate space to carry out this activity and the salary of the operator. The inhabitants should collaborate to segregate and bring their recyclable waste to the *kabaddi* or the corresponding containers.

In order to contribute to this service a tax could be applied to all citizens based on waste produced or other relative criteria or by applying a general tax.

5.3.2. Chimneys

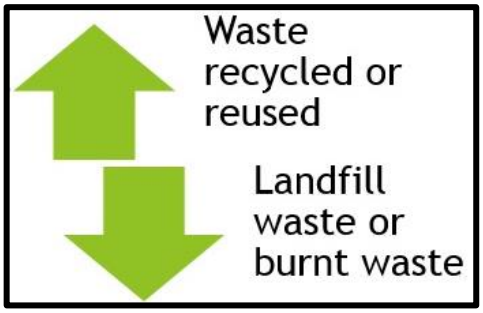
To avoid the inhalation of toxic gases from wood burning or other materials, such as plastic waste in some cases, to make fire for cooking or for the production of heat, it would be good to have some way to evacuate this smoke It pollutes the air of the interior of the houses.

An idea is the possibility of building a fireplace when new homes are built. It might be more difficult to place a fireplace when houses are built yet.

5.4. Awareness activities

It is important that people know the importance of having a correct waste management. They should know the benefits of segregating and recycling the waste, instead of burn it or just throw it away. This can be due to the existing situation, where ignorance, neglect and bad habits are ingrained.

People should be aware of the benefits of a good waste management, and the effects on the quality of life, prevention of diseases, and keeping the environment clean. Also, promotion of participation to engage people on correct waste management should be undertaken and empower them to be part of the change.



In parallel to the proposals and alternatives mentioned in the previous sections, it is important to make awareness campaigns so that everyone knows the benefits of proper waste management. In this activity, Clean Up Nepal can support and provide some materials such as masks, gloves and information posters, both in English and Nepali (Figure 41), since most of the rural population does not understand or speak English. These posters explain the inconveniences of a non-correct waste management and of burning waste, and how it would be a correct waste management and its benefits, we could improve our quality of life, our environment and our health.

Figure 41. Waste awareness Clean Up Nepal posters (English and Nepali)

Awareness activities in school could be also done, through talks, games and dynamics it is easy to teach a lot of things and the younger ones are those who have the greatest ability to absorb new knowledge.

It must be transmitted that things could change among all. Promote public awareness about waste reduction, recycling and reuse. Promote campaigns that have measurable effects on citizens.

Recycling not only reduces contamination and garbage sent to landfill sites, but avoids the extraction of new raw materials, saves energy and combats climate change.

A local person interested on the subject could be trained to carry out these awareness campaigns, since for the inhabitants have more credibility and listen more to an equal than to an outsider.

6. CONCLUSIONS

- The study carried out in Bhimpedi shows that the waste generated by the population is: cardboard, plastic snack bags (potatoes, biscuit, etc), plastic water or soda bottles, cans, different plastic containers, plastic bags, construction bags, cigarette boxes, tetra bricks, glass bottles and clothes. However, the amount of waste that is observed in the rural area is lower than in the non-rural area, due to the commercial activity of the center.

- There is not waste collection point, no bins or containers. People use two ways to get rid of the waste they generate: burn it or throw it away. These ways to get rid of waste are harmful to both the inhabitants and the environment.

- Waste generated during a month was quantified in the orphanage and in some families. For the quantification electronic dynamometer was used.

- According to the results obtained from the quantification of waste generated in the orphanage, the residue that is most generated is the paper / cardboard, and the less generated is sanitary waste.

- The results obtained from the quantification in the orphanage are not 100% reliable as woman who take care of the cleaning of the orphanage emptied bins as a routine of their job, although telling them that for a time we would be responsible of this task.

- It is considered that the results obtained from the quantification of household waste are not conclusive since in some cases the weekly quantification of waste has not been possible, there are some repeated data and from some families data was not obtained. This was due to the short duration of the study, where perhaps there was a need for awareness about the work to be carried out and when seeing how it was evolving, it could have been redirected to obtaining data.

- Some families use plastic waste as an accelerator to make fire to cook, although they know that this is not good for their health.

- The families that run small businesses manage the waste in the two ways mentioned above, burning them or throwing them away. Except for glass (returnable packaging) that return it to the same company where they buy the products for their subsequent recycling.

- Three months is little time for a study of this magnitude. Quantification of waste should be made in a longer space of time to obtain conclusive results.

- Waste management in Bhimpedi is non-existent and is quite deficient in Nepal, generally. The improvement of waste management is necessary since it entails benefits for the population as well as the improvement of both their health and the environment in which they live.

- The main waste management problem is plastic waste.

- Some of the proposals for the improvement of waste management given in this project are viable and, although they do not solve the current problem of waste management, it can be reduced. Always bearing in mind that awareness of a proper waste management is important so that the beneficiaries of the project put their part, as well as the government, in order to be able to carry it out. It is easier with the involvement and collaboration on the part of the population.

- To improve current management proposals should include protection measures during burning waste, production of briquettes to burn instead of plastic for cooking and *kabaddi* implementation. Nevertheless, awareness activities are of main interest to go towards health and environment protection.

7. PERSONAL ASSESSMENT

I have always wanted to go to Nepal, and when I had the opportunity to go on a cooperation project it was like doing two things that I really wanted to do at one go. It has been a totally enriching experience, a great opportunity, I think I have learned a lot more than I could ever teach the people I have met there. Nepal is an extraordinary country, its wonderful culture and its charming people always with a smile on their faces.

When I returned to Barcelona, I thought that I had already come back to reality, everything was "normal", although, really, that was also the reality, the reality of the inhabitants of Nepal and its day-to-day life; you learn to value much more all the things we have here, details to which we do not give importance although I must say that in this small town called Bhimpedi I have not missed anything. I felt very welcome and I could stay there three more months easily.

Regarding to the project, I think that in three months it is very difficult to be able to really achieve what is intended, and it is more difficult in rural areas, where the main problem is communication between the co-operators and the people there. And we also needed a period of adaptation, gaining confidence being in an unknown country and, above all, that people trusted us. At the moment, in our country, the waste management is important, although it is not the case of other countries, there are not the same worries and priorities in the developing countries, but we have to begin doing something, a small action in a long term, could have an important impact.

Nepal is a country where the rhythm is very slow and everything moves very slowly, with that and adding that our stay coincided with the country's most important national holiday, the Dashain, in which the country is practically paralyzed and they have vacations for a whole month, at first it took a while to start, although we could finally do everything we wanted. We have noticed that perhaps three months are a few time, to obtain more data time in Nepal should have been more extensive, although the quantifications have been complicated, the study of the situation could be carried out.

About waste management, which was the reason of the study and the present project, it was a "strange situation" for me. I noticed the facilities we have here in Europe, we throw away our waste in bins or containers, segregated or not, and we do not need to care about how is it managed or where it is going, instead, being in Bhimpedi I did not know how to manage my own waste. All the people burn it, and there were no containers or any place to throw it away, and I did not feel comfortable if I just throw it away on the street or just burn it. What I ended up doing, was to accumulate my waste in a bag, and when I moved to the capital or Hetauda, that was about twice a month, I took my waste to a hotel's bin, in the case of Kathmandu, and in the bins of the street, in the case of Hetauda. It is true that we had not generate as much waste as we generate in our "normal" routine in Barcelona. Life there is simpler and without so many residues, but it is inevitable not to generate any garbage. This has made me realize the irresponsible consumption of society: to buy, to consume and to throw without conscience, contaminating the environment and striking in our own health.

Living with children and workers in the orphanage has been a very nice experience. I have been able to see from inside how some festivals and ceremonies are celebrated, traditions, culture and part of the language. Their happiness is easy to infect.

Finally, I think that when it comes to carrying out a cooperation project, it is important to know what is going to be done there, we obviously knew that it would not have anything in common that we expected with what we found, but at some moments we felt a bit "useless", in the sense that you think that you are going to do something important, but when you are there, in a different place and in another reality, it feels like there are things that are more important. But in short, it has been a very positive and enriching experience that I am sure I will never forget.

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